DOCUMENT RESUME

ED 372 822 PS 022 207

TITLE	The Learning Society.
INSTITUTION	Canadian Inst. for Advanced Research, Toronto (Ontario).
REPORT NO	CIAR-6
PUB DATE	[92]
NOTE	69p.
PUB TYPE	Viewpoints (Opinion/Position Papers, Essays, etc.) (120)
EDRS PRICE	MF01/PC03 Plus Postage.
DESCRIPTORS	Cognitive Development; Cultural Context; Developmental Stages; Foreign Countries; *Individual Development; Information Technology; *Labor Force; Learning; Policy Formation; Program Development; Research Methodology; *Research Needs; *Social Change; *Social Development; Social Environment; Social Influences
IDENTIFIERS	Global Change

ABSTRACT

This publication focuses on the challenges faced by modern societies as they seek to plan for competing in the global economy, educating the population for new competencies, maintaining the social fabric for nurturing and socializing the next generation, and providing opportunities for the health and well-being of all citizens. Emphasis is placed on the need for understanding the processes of human development as a vital component of the planning process, noting that such an understanding starts with recognizing the social nature of the human species and the powerful impact that social environments have on human development. The first section of this report explains how contemporary social structures and practices affect individual and collective development. Topics explored include: (1) basic needs for positive human development during infancy, early childhood, transition to school, puberty, and adulthood; (2) the impact of the social environment on human development; (3) information technology and the creation of new learning opportunities; and (4) the necessity for linkage and integration in developing a conceptual framework and a common language. Subsequent sections of the report examine in greater detail the current dilemmas of modern technological societies, developments in the human sciences that inform any attempts to make important decisions, and the relevance of this information to economics and health. Other topics discussed are the social cost of failure, family sociology and behavioral epidemiology, and building a new framework for understanding the determinants of human development. Contains 70 references. (SM)

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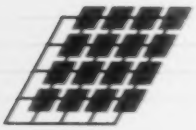

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CIAR Publication No. 6

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1.0 Overview

Modern societies face difficult new challenges as they seek to cope with global economic competition, the need to educate for new competencies in the population, the maintenance of the social fabric for nurturing, socializing, and educating the next generation, and the provision of opportunities for health and well-being of all citizens. As the pace of social change accelerates, it becomes increasingly important that the basic requirements for healthy human development be included in thoughtful planning.

An essential component for such planning is a deeper understanding of the processes of human development. Such an understanding starts with a recognition of the fundamentally social nature of the human species, and thus the powerful impact that social environments have on human development. These influences are powerful throughout the lifespan, and particularly so during early life. In this, we are similar to other social primates. Providing for critical developmental needs in the context of modern societies, however, poses new challenges. To meet these challenges, we need to understand more deeply how current social arrangements affect the provision of basic developmental requirements, and also to anticipate how social changes, driven by rapidly emerging technologies, will affect future arrangements.

In the first section of this proposal, we examine in summary fashion some fundamental features of human development and of human social environments. We consider how contemporary social structures and practices affect both individual and collective development, and explore the likely impact of ongoing social changes. In subsequent sections, we consider in greater detail the current dilemmas of modern societies, report on pertinent developments in the human sciences that inform our attempts to make important decisions, and propose ways to integrate this information to improve its coherence and utility.

1.1 Humans: A Social Species

Humans are a social species. Throughout our lives, we play, work, interact, learn, and reproduce in social groups. We develop in social relationships from the earliest period of life, and we remain dependent longer on caretaking for our survival than any other primate. At our core, then, we need social groups to survive.

The nature of our early experiences -- most of which occur through social interactions -- plays a critical role throughout life in how we cope, how we learn, and how competent we become. The nature of the social environment in which we develop is thus a key determinant of our quality of life. Although experiences in infancy and early childhood play a central role, there are critical developmental periods throughout the lifespan: transition to school, puberty and the adolescent transition to adult roles and responsibilities, career and personal transitions in middle adulthood, and changes in working commitments in later adulthood. In each of these transitions, aspects of the social environment play a crucial role. Diverse life outcomes -- positive and negative -- are closely associated with identifiable differences in social experiences.

In turn, the quality of the human social environment is a function of the competence that is available within the society. The nurture, education, and socialization of new members of the group depend on the skills possessed by more mature members, and on social arrangements that facilitate high quality interactions between generations.

Almost all of this is equally true for our primate cousins. This is perhaps not surprising in light of the genetic similarity between humans and non-human primates -- a 95% or higher overlap of the genetic code in most comparisons. Among Rhesus macaques (like us, a social species), the quality of early attachment relationships, the opportunity for broad social interaction within the troop, and the stability of the troop during critical developmental periods, all play a role in eventual competence and coping skills.

But we face additional challenges unknown to other species and to our own quite recent ancestors. The stunning speed of our species' experiment with civilization has led to previously unimaginable growth in knowledge and technology, but has brought with it a host of novel problems. The shift from nomadic hunting and foraging or collective settled foraging to agriculture, urbanization, global trade, the industrial revolution, and now the information revolution, has occurred in the blink of an eye in evolutionary terms. From this perspective, it is perhaps understandable that we have yet to work out the challenges that beset this experiment. Evolution never anticipates the future; it is only an historical record of prior adaptations. Our ability to respond effectively to these new and rapidly shifting challenges is thus dependent on cultural rather than biological adaptation.

Different cultures and societies have arrived at different solutions to the dilemmas of modern social organization, and we can learn much from the comparative study of these societal adaptations. Some solutions work better than others for some criteria of success, but no single solution is likely to succeed. Cultural forms are not interchangeable parts; what works in a particular setting may not easily transfer to a different cultural pattern. As well, historical demands shift over time, and some contemporary successes may be due as much to historical contingency as to cultural adaptations.

Awareness of these contextual factors helps our efforts to understand better the fundamental needs of human development and the key aspects of the social environment that affect development. Our study of social environments and their impact on human development must include comparisons across many cultures, and range from our evolutionary heritage to the modern era of rapid social change. We need to be alert to the physical environment as well, both in terms of how it affords appropriate stimulation and how it affects the social environment. The more we know about basic developmental needs and how the quality of the social environment affects human development, the more likely we are to include these concerns in our individual and collective decisions.

1.2 Human Development's Basic Needs

What are the basic needs for positive human development? The answers depend partly on definitions. At one extreme, some may define basic as including only physical survival; at the opposite pole, others may regard the opportunity for self-actualization as basic. Similarly, what one regards as positive inherently involves value questions. For example, the relative weights placed on affiliation or social goals and achievement or career goals show consistent gender and individual differences.

Further complicating the question is the recognition that changes in social practices in turn transform what are viewed as basic developmental requirements. Literacy is a prime example. The ability to make sense from and communicate with arbitrary visual symbols is relatively recent in human history, yet we now view such a skill as virtually essential to full participation in the modern world. Literacy rates of a population are widely regarded as a key index of the success of a modern society, and children who have difficulty in acquiring this expertise are likely to face life-long challenges.

As we might expect, there is widespread consensus on the desirability of many of the most important developmental outcomes, as is true regarding health outcomes. In the same way that life and health are viewed as inherently preferable to mortality and morbidity, there is broad agreement that many developmental accomplishments -- the ability to make effective social connections with others, competence in the tools and skills of the culture and the opportunity to make productive use of them, good coping skills, healthy response patterns in the face of stress, perceived control over one's life, a sense of psychological well-being, and good self-esteem -- are preferable to their opposites. Each of these developmental outcomes has roots in our early experiences, each continues to be important (and potentially malleable) throughout our lifespans, and each influences the quality of our lives and of the contribution we can make to the effective functioning of the society.

Bearing in mind these important defining issues, we need to focus our attention systematically on understanding the fundamental developmental processes that yield the outcomes we choose to value. The option of not confronting these central questions --"letting nature take its course" -- is to define human developmental concerns as irrelevant to basic societal choices, in contrast with the extensive consideration given to economic, environmental and other consequences of those choices. We need to include key developmental concerns in societal decision-making. This grows more important as the pace of social change accelerates, shortening the time available for cultural responses.

Fortunately, we have begun to understand many of the key developmental processes and how social and physical environments affect them, although much remains to be learned. One can place some of the key developmental markers along a time-line of the lifespan: birth, infancy, early childhood, beginning school, puberty, family and/or career formation, workplace adaptations, adjustments in later adulthood. Each individual's perceived time-line is unique, of course, but many common patterns emerge. We can use these patterns to explore some of the more important developmental transitions. In this overview, and in subsequent sections, we highlight some of the needs pertaining to major developmental transitions.

• Infancy and Early Childhood. We now know that humans are capable of learning beginning no later than birth, and that their ability to begin making sense from complex arrays of information grows exponentially in the early years. There are many critical developmental tasks in this early period, and their accomplishment depends substantially on the nature of the social environment.

The first critical need is the establishment of a secure attachment with a nurturing adult. The quality of this early attachment relationship has been found to be related to a range of life outcomes in studies of humans and of non-human primates. Most often this responsibility falls on the mother, although effective parent-child interactions are not restricted to biological parents. Across several longitudinal studies, in fact, the experience of a surrogate attachment relationship has been identified as a highly significant buffering factor for high-risk children. In cross-fostering studies of Rhesus macaques, infant monkeys bred to be highly stress-reactive have been placed with foster mothers who had high status and were highly nurturant. Compared with the more usual negative outcomes for these vulnerable monkeys, those who had surrogate parenting were virtually indistinguishable from normal animals in later life, and indeed some achieve high status in the group.

Only a few of the many potential connections between the quality of early attachment and developmental outcomes have so far been studied. But it is clear already that such central characteristics as our styles of relating to other people, the way in which we see and interpret information in the world, and our patterns of emotional and behavioral self-regulation, have all been implicated empirically. As we learn more about these processes, we may come to a better appreciation of the power of these early experiences. The groundwork for eventual competence, coping, and health seems to be laid quite early.

In the early stages of life, dramatic developments are also occurring in the neural system. For at least some sensory systems, there are critical periods for cortical development; some of these periods may last only a brief time. If the appropriate visual or auditory experiences are not available during this period, lifelong disruption in the ability to make effective use of that specific sensory channel can occur. Similarly, particular patterns of how we respond to novelty or stress that are acquired early in development can persist throughout life. When reactivity to stress is elevated (for example, through frequent perception of threat or heightened fear of novelty), so too is the immune system's response, which is part of the host defense system. Part of this feedback system is the release of corticosteroids, one of whose purposes is to alert the nervous system to prepare to respond. Small but not insignificant amounts of neuronal death accompany the release of corticosteroids, leading over time to organic changes that may compromise health in a variety of ways. There is also evidence that these patterns -- perceptual, cognitive, emotional, and behavioral -- become a fundamental part of the individual's neural organization. Explorations of this interconnected development of brain and behavior are underway; here, a major role is played by the rapidly accelerating technologies for the visual imaging of neural system structures and functions.

The acquisition of fundamental cognitive and language competencies is a major milestone of infancy and early childhood. Differences among individuals in their eventual attainment of competence and expertise have their roots in these early accomplishments. This is so for several reasons.

Acquisition of competence and expertise (in the fields of human endeavour that have been studied to date) appears to be a long-term process, one that is generally gradual, but also marked by periods of rapid, qualitative reorganization. The evidence suggests that the nature of one's previously acquired knowledge serves as a major constraint on the form that later learning in that area will be able to take. Another source of developmental diversity in these acquisitions is the repetitive feature of many feedback systems. Consider a child whose early social interactions have led him or her to resist attending to negative stimuli. Given that much of our learning comes from attending to errors, such a child may systematically exclude important information that in turn could have led to improved performance. The consequences are obvious for the attainment of a variety of competencies by this child compared to a confident and curious child.

In other words, what we can learn at any point in our development is constrained in two important ways: how much we already know, and how we approach the learning of new information. When we reflect on the fact that many of these learning patterns are being sculpted as enduring neural networks in response to our experiences and interactions, we begin to appreciate the scope of effects arising from our earliest experiences -- and thus the importance to the individual and to society of arranging the next generation's experiences so that they afford healthy nurturance, stimulation, and structure.

• Transition to School. The human developmental diversity that is already evident by age five or six years is considerable. Numerous influences have had an opportunity to shape the way we listen, talk, think, and interact with others. Different patterns of performance have been associated with differences in social class, gender, and ethnicity. Not surprisingly, socially more advantaged groups tend to outperform less advantaged ones on standard criteria, and many of these differences are well-established prior to school entry.

Schools and teachers have often assumed that children entering the school system will have acquired the cognitive and social interactive styles found most often in the mainstream group (in North America, white and middle class). When curriculum and instruction operate on this assumption, children from outside the mainstream may encounter significant learning difficulties -- even though they may be quite capable of learning the same material if developmentally and culturally appropriate learning experiences were available.

Evidence from a number of longitudinal studies makes plain the critical nature of this transition to school. Poor academic and social performance in the early grades is a very substantial risk factor for subsequent academic and behavioral problems well into adolescence. Given the cumulative nature of expertise acquisition, we can appreciate the long lasting difficulty of weak conceptual foundations, especially in such central conceptual structures as mathematics. Of course, the relative weakness in mathematical concepts that characterizes many North American teachers in the primary years is an added hindrance in this area.

But there do appear to be ways to include more children in effective early education experiences. To date, the majority of these have focused on attempts to help the child develop the skills and learning styles that will be needed in traditional schooling -- such as Head Start and other compensatory preschool programs. Although the evidence is mixed, there are good grounds for believing that there have been long-term positive effects of such interventions. Most of these effects, though, have been found in social or behavioral rather than academic or cognitive domains, and the magnitude and scope of the effects have been less than some had hoped. Like some medical conditions that can not be dealt with by a single inoculation but do respond well to ongoing forms of therapy, fundamental discrepancies between a child's way of learning and the school's way of teaching do not vanish after one-shot interventions, but may respond to ongoing attempts to make learning opportunities more developmentally appropriate.

There are other schooling adaptations that have demonstrated promise in North America and elsewhere. The first of these can be broadly termed cooperative learning. Although there are many variants of this notion, only a few of which have been studied carefully, one common core is the recognition of the social nature of learning and knowledge. In contrast with some traditional Western folklore that viewed knowledge and expertise as an exclusively individual possession, knowledge and its acquisition are seen from this perspective as inherently social. In Japan, for example, the transition to schooling is organized with a primary goal of teaching children how to work effectively together in learning activities during the early years; academic concerns are a lower priority in the early grades. This approach seems to enable rapid academic progress in subsequent years. And in North American studies, creating the opportunity for meaningful discourse among students and between teachers and students has been linked to broad performance gains. Even in mathematics, traditionally viewed as a less appropriate topic for interactive discourse than the humanities, the opportunity for collective effort seems to forge stronger links between students' conceptual and procedural knowledge.

A second positive trend is toward adaptive instruction. This has arisen in response to some important social changes. As diversity in our society increases -- spurred by immigration, a growing awareness of our multicultural character, and deeper economic divisions -- so too does the developmental diversity among children in schools. In turn, it becomes increasingly inefficient to regard as truly educable only those children who can develop learning styles that conform to an a priori standard, and to regard other children as flawed in some fundamental fashion (although we often hope that remediation might offer some help). The dramatic increases in children labelled as learning disabled -- even though in careful studies most of them do not actually fit the diagnostic criteria -- are placing a heavy burden on schools. And since each decision regarding the need for special services requires a quasi-judicial process that can be appealed at several levels, scarce educational resources are increasingly absorbed in documenting and defending these decisions.

It may prove more effective in the long run to discard the assumption that all children learn in pretty much the same way. Then, instead of intensive efforts to prepare less advantaged children to adapt to the standard forms of schooling, schools and teachers could focus their efforts on adapting instruction in order to find an appropriate developmental pathway for each child. This requires major institutional innovations in order to work, including reexamination of professional training and professional roles; on the other hand, current educational crises are encouraging such basic rethinking. Productive linkages between cooperative learning and adaptive instruction can be imagined, in that one of the most effective means of discovering learning styles and developmental levels is through ongoing discourse and interaction.

However accomplished, the acquisition of important concepts, skills, and habits of learning during the early school years is crucial to eventual academic success. The evidence suggests that such acquisition is attainable by nearly all children, if feasible developmental pathways are available. Schools, of course, can not be solely charged with this responsibility. Families play a major role in the child's school success, as emphasized by recent evidence on the remarkable progress of some Indochinese refugees who have fled to North America -- surely a high-risk population. Such evidence also highlights the impact of the broader social environment on learning, an impact that probably equals or exceeds the impact of formal schooling in many instances.

The ability to create multiple pathways for the development of competence will become a critical factor in a society's success, as the breadth of competence throughout the population plays an increasing role in economic productivity in an information age.

• Puberty and Adolescence. Puberty brings on the most significant biological changes for the human organism since the earliest years of life. The gradual attainment of reproductive capacity requires many shifts in the neural, hormonal, and immune systems, and these have further consequences for all aspects of physical and psychological development. Attending to these important transformations, most human societies -- modern and traditional -- have viewed the time around puberty as significant for making life choices and for accepting the responsibilities of full membership in the society. Traditional societies have often used brief but intense initiation rites to mark these transitions. Although modern societies tend to have longer and more ambiguous transformations, the themes of self-definition and social integration endure.

Many contemporary adolescents have more choices to make than their ancestors, due to the complexity of roles that characterizes modern societies. On the positive side, this offers a broader range of choices in constructing a sense of identity and meaning. On the other hand, the complexity of choice itself can be immobilizing, locking some adolescents in a perpetual cycle of role exploration. This may be particularly difficult for adolescents who are acutely sensitive to the approval of their peers, and thus may make choices against their own self-interest.

One manifestation of this is the loss of mathematical and scientific talent that arises from gender stereotyping. Social beliefs that such interests are fundamentally masculine -- held more strongly by men than by women -- convey both overt and subtle messages to adolescent girls that ardent pursuit of such interests is unseemly. This social pressure peaks at a critical developmental juncture: when girls are most sensitive to social ostracism; when the more impersonal, competitive educational practices of secondary education are first introduced; when critical periods in the development of logical and critical thinking are occurring; and, finally, when the pursuit of study in these areas first becomes optional. This developmental picture helps us understand why differences in academic success persist between equally talented boys and girls.

For some adolescents, economic and social marginalization greatly constricts the breadth of available choices. Some of the most serious effects of social marginalization become dramatically apparent at adolescence. Youth who have a history that includes having been temperamentally difficult as an infant, interaction with a caretaker (most often the mother) who did not exercise consistent control during early childhood (often because of factors such as economic stress or family violence), and a poor transition to school academically and socially, often find themselves with few options by early adolescence. Adolescents with this developmental history frequently choose to associate with similarly troubled youth, confirming a pattern of conduct disorder and anti-social activity that may continue to escalate, leading eventually to an increased probability of becoming a perpetrator and/or victim of violence. Less dramatic consequences, such as dropping out of school, are also common, and may have lifelong impact on competence and coping.

A central feature of the adolescent transition, though, is that it represents one of the most promising opportunities for redirection of developmental pathways that soon become much less flexible. Studies have identified the establishment of a close connection with another person as one key factor in such transformations; these connections may function as a second chance to experience a secure interpersonal attachment.

Although differences among individuals increase during adolescence, all adolescents seem to share some common needs -- whether for continued positive development or for redirection of problematic pathways: adult role models and mentors with whom they can have a substantive relationship; adequate opportunities for exploration of life choices; realistic opportunities for productive work in their future; and a variety of peer interactions, including those that engage youth in cooperative efforts on meaningful tasks. To the extent that existing arrangements do not meet these needs -- due to rigidity in traditional patterns of schooling, to the deskilling nature of many entry-level jobs for youth, to the pervasiveness of a shopping mall culture reinforced by commercial media images, or to other factors -- we should not be surprised by evidence of alienation among adolescents and youth. To provide for these needs, we will need to understand more clearly the nature of the society to which we expect them to contribute, and to invent or renew institutional arrangements that encourage healthy and confident transitions to adulthood.

• Love and Work: Developmental Tasks in Adulthood. As in other periods of the lifespan, our competence in learning, coping, and relating to others during adulthood is significantly constrained by patterns established earlier in development. These developmental patterns play a significant role in how we make connections with others, particularly in forming new families, and how we become productive contributors to society. These two activities -- to love and to work -- engage the sustained attention and effort of the majority of adults.

In contrast to the optimistic expectations of mid-20th century prognosticators, who relied for their predictions on the savings of time and effort afforded by rapidly advancing technologies, conflicts between the two important tasks of adulthood appear to be increasing rather than decreasing. In recent North American surveys, adults report having less leisure time now than twenty years ago. Many factors have apparently contributed to this. Two that stand out are increases in the number of dual career families, leading to strains on child care and housekeeping responsibilities; and the geographic spread that characterizes modern urban growth, leading to sharp increases in average commuting time. The latter is another example of how changes in the physical environment can shape important features of the social environment.

Dramatic shifts in the labour market have also changed the nature of adult development. Career trajectories that do not include substantial restructuring at some point during the working life are becoming the exception rather than the rule. Such changes are often traumatic. Being laid off in an era of declining employment and in the absence of systematic programs for retraining has numerous secondary effects, increasing the strain on the individual and on the family. Becoming unemployed has been linked by research to rather rapid erosion of self-esteem and to marked increases in family violence. To prevent these negative outcomes, it may be necessary for society to anticipate and counter these effects by redefining the nature of changes in employment status. More widespread opportunities for retraining or continuing learning may serve these goals.

Several key needs of this developmental period can thus be identified. Organizations of all sorts need to acknowledge the changing nature of family structures. The presumption that each family will have one adult working outside the home and one homemaking adult per family is no longer valid; such households are now a minority in North America. Greater flexibility in working arrangements is needed to reduce the stress that accompanies policies based on outdated assumptions. Important here are such issues as parenting leave, high-quality, affordable day care and worksite day care, and workplace policies that allow employees to have adequate time with their families.

A second support for healthy adult development is that career opportunities not end prematurely. Opportunities for continuing education and retraining -- both in and out of the workplace -- become increasingly important as changes in the labour market accelerate. This needs to include adults who have been out of the labour market for a variety of reasons but now wish to return.

In considering how to build such lifelong learning opportunities, two themes noted in the section on schooling are echoed. One is that not all individuals learn in the same way. Sensitivity to differences in learning styles and in levels of existing expertise is required, and a multiplicity of educational approaches designed. The second is that we may need to focus on socializing adult workers to feel more at home with collaborative and socially connected working arrangements, if organizational trends continue in their current direction (see Section 1.4). Many adults have not had such experiences in school or at work, and thus the likelihood that such patterns of learning and interaction will arise spontaneously is small.

As we grow older, the frequency of health problems increases. But many factors in addition to age have a major impact on health. Social class, for example, is robustly related to health outcomes, and this gradient includes not only comparisons of the middle class versus the poor, but also gradations within the middle and professional-managerial classes. Two key factors, social support and perceived control, have been associated with this gradient. Although we do not yet fully understand the causal connections, it appears that a network of close personal relationships acts as a buffer against the negative effects of stress, and that a sense of control in one's life offers similar protection. Societies that foster the development of these coping skills in early life and encourage their expression in adulthood are likely to have more positive outcomes in many areas, including health and well-being among adults and stable and supportive family environments for children.

• Later Adulthood. Recent evidence suggests that the ability to learn new skills, acquire new knowledge, and sustain vigorous interests in other people and in the world can be maintained until very old age, under favourable conditions. One basic condition supported by research is the active exercise of curiosity, learning, and social interaction. Fundamental cognitive skills and flexibility remain intact longer among older adults with higher levels of these activities.

It is to the clear benefit of older adults to have the opportunity to remain involved in challenging activities. Social arrangements that encourage such involvement confer a range of health and other benefits. Age segregated neighbourhoods and rigid retirement policies are two factors (among many) that may in fact discourage such involvement. They may also discourage the maintenance of long-standing social support networks that are strongly associated with positive health outcomes in the later adult years.

Less often noted, however, is the loss to society. The expertise, including expertise about life (or, more simply, wisdom), that has accrued over a lifetime is a valuable social asset. Vast experience in the workplace, in family and interpersonal relations, and in child care has often prepared older adults to make valuable contributions to the society in diverse ways. Societies that find innovative ways, or reinvent traditional ones, to tap this resource are likely to benefit substantially, as are individual adults during their later developmental periods.

1.3 Social Environments in the Modern World

In the examination of developmental needs at different points in the lifespan, it is clear that the impact of the human social environment is substantial during all periods of development. Bearing in mind some of these critical developmental needs, we can examine more thoughtfully our current social environment. As in the previous section, an illustrative rather than exhaustive set of issues is considered.

Some of the more problematic aspects of the modern social environment have already been implied in the examination of developmental needs. During the early years of life, opportunities for establishing secure attachments, for extensive and stimulating social interaction, and for safe exploration of the physical world are all important to the development of competence and coping skills.

For many young children, social factors work against these opportunities. Due to economic constraints, many families require that both parents work to maintain a decent standard of living. Beyond economic considerations, the opportunity for women to participate in the work force on an equitable basis is important in itself. Combined with limited, expensive day care options and with inadequate parental leave or flexible work arrangements, the consequence is that the developmental needs of many children are not met. These strains are often greater in the increasingly frequent single-parent households.

Children of poverty face even worse problems. In many cases, provision of even basic nutritional needs is problematic; hundreds of thousands of Canadian children are dependent on food bank supplements that are not always adequate. Poverty is also a significant risk factor for exposure to family or neighbourhood violence, and for the development of aggressive behavior patterns with lifelong developmental consequences.

It has often been assumed that schooling, as the organized and formal effort of society to socialize the next generation, will provide a restorative function for children, and thus minimize the long-term consequences of a poor social environment in early life. The evidence suggests that this is a misplaced hope. Schools are part of society, not apart from it, and the forces that operate outside schools are usually found to operate inside them as well. The social class gradient in academic performance is evident at entry to school, and remains strong throughout the school years, reflecting in part the degree of matching between home and school curriculums in the early years.

Even within the middle class, however, the increasing proportion of children who are identified as needing special services to deal with learning difficulties is an indicator of more widespread problems. Increasing attention has been directed to these broader issues, as researchers examine how capable the existing structures and practices of schooling are to meet expanding demands for technical expertise, cooperative learning, critical thinking, and ability to innovate. Classroom time surveys suggest that there is very little opportunity for discourse, and avoiding errors is sufficiently emphasized that the discourse that does occur is rarely meaningful.

Education, of course, does not operate in a vacuum. Surveys suggest that most North American children and adolescents spend as much or more time watching television as participating in formal instruction. Many of these messages are more powerfully persuasive than those that school can deliver, and the medium itself may inculcate habits of mind that conflict with educational goals -- impulsive rather than reflective, for example, or guided by emotional associations rather than thoughtful analysis. Of course, it is possible to imagine the use of these powerful technologies to meet the developmental needs of children and adolescents, and emerging work in this area is promising.

One broad social factor that complicates our ability to meet developmental needs is the separation between individuals and the alienation of individuals from society. Numerous aspects of this phenomenon have been investigated, but their common theme is that the erosion of social connectedness is tied to a host of problems. One example noted above is the pattern of age segregation that characterizes much of North American society, and that gets in the way of mutually beneficial exchanges between generations. Other factors contribute as well, such as the social distancing in urban centres where high-rise residential development makes the formation of neighbourhood communities difficult. To the extent that we share with our fellow primates a need for a sense of belonging to an identifiable group (family, troop, tribe), those societal features that obstruct such connectedness may compromise a wide range of developmental needs.

We need to consider the potential strengths as well as the problems in examining the impact of the social environment. Both Canada and the U. S. have substantial economic resources, despite recent difficulties, and high living standards, on the average. Their intellectual and technical resources are extensive, and they enjoy relatively high levels of educational attainment in the population. One often overlooked resource is multicultural diversity. Although often viewed as a difficulty to be overcome rather than as a strength, and although some advantage may accrue at present to more monocultural societies (such as Japan), the potential strength of a diverse storehouse of useful cultural solutions needs to be recognized and developed.

A final resource particular to Canada is a history of substantial attention to social and collective responsibilities, as shown, for example, in health and income maintenance policies. The opportunity for informed discussion of the societal arrangements necessary to meet pressing human developmental needs thus takes place in the context of a longstanding engagement with these concerns. The keys to marshalling these resources include a better understanding of fundamental developmental needs, and sustained attention to how these needs can be met in a modern society.

1.4 Facing the Future: Information Technology and the Learning Society

How do we marshal these resources to meet rising challenges? One critical facet is to recognize that in the emerging economic world, the potential for innovation and the collective talents of a population are likely to be relatively more important to success than in the industrial era. Natural resource extraction and industrial manufacturing require much human labour, but, compared to emerging innovation-based economies, do not make the same demands for widespread intellectual and technical competence in the population -- including not only literacy, but also numeracy, scientific literacy, and the ability to use evolving information technologies. Human resources are thus likely to be critical to future economic success. Understanding the fundamental features of human development is thus essential. Second, we need to plan not only for the present, but must also anticipate the direction of current social trends. Solving yesterday's problems is important, but anticipating tomorrow's is both more difficult and more crucial.

Perhaps the most predictable social trend at present is the increasing impact of technological innovation, particularly in the area of information technology. Societies that provide for the development of the expertise needed to participate actively in this emerging global information network have better economic prospects, not only as beneficiaries of expanding knowledge, but also as potential producers of innovation and the wealth-generating capacity that accompanies innovation.

Expanding the base of relevant expertise is not an easy task, quickly confirmed by an examination of illiteracy rates even in North America, where economic resources have been relatively strong over the last 40 years. In addition to literacy, some expertise in mathematics, science, and information technology is likely to be needed. Our current North American trends in these areas are not reassuring, both in terms of average performance levels relative to other modern societies, and of the proportion of students pursuing such interests through adolescence.

But the picture is not entirely bleak. The new technologies themselves create new learning opportunities, many of which can (and have) been designed to be more engaging and facilitative for a broad range of students. The new technologies also afford the opportunity to individualize the process of acquiring expertise.

The new technologies have also generated an increasing recognition of the social nature of knowledge itself. If it is the case that connected networks of expertise are generally more productive than experts working alone or in small enclaves, the ability to work effectively in such networks will be increasingly important. There is already considerable evidence that various forms of knowledge networks in school situations (for example, cooperative learning, discourse-centered instruction, computer supported information exchange) raise both group and individual performance levels. Some studies have included not only specific content knowledge gains, but also increases in critical and creative thinking, and in the ability to communicate effectively. Individuals with these experiences in their earlier development are more likely to work effectively in such networks after their school years, and these skills are becoming essential for productivity in many workplaces.

But schools alone can not bear the burden of developing such skills. Due to the rapidity of technological change, it is no longer realistic to believe that the specific skills acquired by late adolescence will remain adequate for one's working life.

Continuous learning across the lifespan is a more realistic expectation. Employers' expenditures for training already nearly equal the total social expenditures on schooling, but much of this is in the form of training new employees to do some specific task. When the task changes, a new training regimen is instituted, often with more new employees. As the demand for workplace adaptation increases in frequency, the efficiency of this traditional model drops.

A different approach that has been proposed is to integrate as many people as possible in the process of ongoing organizational and technical innovation. An example is the decision by Xerox to incorporate on-site service providers and those working on technological innovations into a single information network. An implication of this model is that employers would need to view their training investments as less job-oriented and more person-oriented. That is, investment in training with this approach has two goals: to enable the current work to get done; and to increase the broad pool of expertise available to the organization.

Workplace arrangements that permit such an expertise network to function require new attention, especially regarding the issue of centralized versus decentralized decision-making and control. If, as the evidence suggests, perceived control is an important component of effective coping, and if this develops only in situations that permit the actual experience of control, then the exclusive reservation of decision-making power to the top of a hierarchy may be counter-productive to its success. Such top-down networks are generally less efficient in many systems, from artificial intelligence to human cognition. And in not making use of all the expertise that is in fact available to them, such organizations run the risk of actually diminishing the pool of expertise, as individual skills atrophy and as individuals choose, in the absence of feedback, not to participate in the network.

A further implication is that the value of an employee to an organization increases over time, thus requiring reconsideration of current practices on downsizing and retirement. In other words, organizations will need to pay increasing attention to the impact of employment decisions on human development factors, rather than attending only to the functions performed by their members.

The use of the collective expertise of all members of an organization has an added benefit in the versatility that typically accompanies diversity. Two kinds of diversity may be encouraged by this shift in focus. The first occurs within individuals. As individuals experience a broader range of tasks and challenges, their cognitive complexity and ability to problem-solve increase and become more flexible. The second is the diversity between individuals. If workplace constraints are quite narrow (as in the traditional manufacturing assembly line), then workplace skills and attitudes are likely to develop similarly across the population working within those constraints. With broader constraints -- for example, those that encourage a focus on the higher-order goals of the organization in addition to the specific task at hand -- it is likely that a collectively more diverse range of skills and talents will emerge. In both these senses, then, diversity is a strength rather than a problem, a benefit that accrues with investment in human development.

In the broadest sense, then, modern societies will need to become learning societies in order to attain (or retain) their ability to participate successfully in the global economy. And although the notion of a return to isolated self-sufficiency is romantically appealing to some, it is not a realistic option at this historical juncture, given the already existing level of global economic interdependency.

To meet these current and future developmental requirements, then, there is a great need for institutional and social innovation. Although many of the problems are endemic to the human condition, the forms that the problems take are new. Central to thoughtful efforts to construct a learning society is learning more about the determinants of human development, and how they are affected by the environments in which we live and work. Based on the trends described above, the evolving relationship between individual and collective needs in modern societies is one element that merits serious reflection.

1.5 On Common Ground

Perhaps the earliest consensus to emerge on the CIAR Task Force on Human Development was the necessity for linkage and integration across the wide range of topics and the many levels of analysis that are inherent in trying to understand the determinants of human development. Some sense of that range and scope is evident even in this brief overview.

In our attempts at integration, we have focused on three areas: a common conceptual framework, a commitment to work on integration in our common discussions and in our own work, and a common language. In the final sections of this overview, our progress on these fronts is briefly summarized. It should be clear, however, that this notion of integration implies an agenda for the future rather than a fait accomplis.

• The Developmental Method: A Conceptual Framework. Our understanding of the fundamental determinants of human development is enhanced when we are able to see the key transitions as a developmental time-line. The influence of early patterns -- social, cognitive, behavioral, neural -- on later experiences, and the reciprocal impact of those experiences on shaping those very patterns, can be appreciated most easily in their historical, developmental context.

Our understanding of the relationship between the nature of the social environment and human development is further enhanced when we examine the inherent feedback systems that are operating. We encountered three critical feedback systems in our consideration of basic needs of human development. The first occurs within the individual, such as the linkage between the neural system and the immune system. Exploring the development of this intraorganismic feedback function, for example, will be crucial to understanding how stress reactivity is related to immune activity, health, and perhaps even to learning.

The second feedback system operates between the person and the environment. During critical periods of cortical development, for example, there is a fundamental requirement for specific kinds of sensory input; in their absence, neural organization is fundamentally different, and this in turn impacts on the sensory information available during later development. Another example is the establishment of a style of attending (or not attending) to important information in the world, a style that has its roots in the social interactions with the caretaker in early life. This style shapes the kind of information that gets in and how that information is interpreted -- in turn influencing subsequent cognitive growth.

A third important feedback function occurs at the population level. The generally available competence and expertise in the society is a function of the developmental histories of the individuals in the population. These resources are crucial components for the effective functioning of society, including economic productivity, the ability to nurture, educate, and socialize younger members, and population health. These population outcomes in turn create the conditions for the development of competence in succeeding generations. Such an analysis helps us to understand how some social practices -- such as the breaking of connections between older adults and younger people -- may interrupt this cycle.

Keeping in mind these developmental perspectives -- historical contexts, intraorganismic feedback systems, person-environment interactions, and population effects -- permits us to grasp the centrality of the human social environment to human development. Explaining the nature of these effects is not as easy as recognizing their existence, but there are conceptual breakthroughs that promise to assist in that effort. Such assistance will be welcome, as one task that the program will surely face is the necessity for conceptual and methodological innovation.

Longitudinal analyses are central to uncovering developmental changes that occur over time and in studying a variety of feedback functions. Recent advances in the ways of exploring longitudinal data have occurred together with progress in making archived longitudinal data bases more readily available to the scientific community. More broadly, there has been an increasing recognition of the need to exploit a range of analytic techniques, and to form productive linkages among diverse methodologies. Uncovering key developmental patterns is the common thread uniting quantitative and qualitative approaches, experimental analyses of regularities and differential analyses of diversity, and observational methods of natural phenomena with evaluations of interventions.

Indeed, the developmental method can be seen as synonymous with attempts to integrate methodological approaches in pursuit of a common goal. One particular manifestation of this is the attempt to integrate the analysis of developmental markers and the exploration of developmental processes. The goal of such integration is to paint a clear picture of the relationships among important developmental factors and outcomes, but also to understand what developmental processes gave rise to the observed relationships. Demonstrating the contribution of social support to health is an example of a marker-type analysis; understanding how social support functions in this context is a process-type analysis. Obviously, these two approaches complement each other, and present important opportunities for integration.

Several kinds of feedback systems were noted above. Analyses of dynamic systems in a variety of fields (including some areas of human development) have generated valuable concepts that can help to analyze such reciprocal causality. Complex dynamic systems are characterized by repeating functions in which outcomes at one time are later fed back into the system (known as iterative feedback functions). Such iterative feedback functions can lead to structures that are self-organizing. With the use of these emerging concepts, many developmental structures can be productively explored. The goal is to identify coherent patterns and processes that underlie the surface complexity.

• The Integrative Process. The availability of new conceptual and methodological tools is a promising first step, but we anticipate that the actual process of integration will eventually be more important. This is of course a major goal of the proposed program, in creating a network among scientists from various disciplines working on this topic. But some examples of the impact on particular research programs arising out of the task force discussions can be briefly noted; more details can be gleaned from later sections of this document.

Case has expanded his long-standing concern with the development of central conceptual structures to include a deeper examination of factors in the social environment that impact on the acquisition of such structures. The implications of the robust social class gradient in the acquisition of the notion of a number line have been probed in his current work. Cynader's extensive work on cortical development, particularly in the visual cortex, and on the sensory stimulation on which such development depends, has been informed by consideration of a broader range of developmental acquisitions that rely on cortical development and of the aspects of the social and physical environment that impact them. Under what conditions, for example, might higher-order cortical functions, such as cognitive flexibility or coping skills, have critical periods, and what experiences are likely to influence their development? Keating has restructured his investigation of adolescent stress and coping in everyday life to place the original developmental questions in a population perspective, and to examine the connections between markers in terms of underlying processes. Perceived control, for example, emerges as a buffer against stress in these analyses, but how it operates, and whether it operates similarly in different demographic groups, are new questions that are being investigated as a result of the task force interactions.

Examples could be multiplied, but the picture that emerges is already clear. Attempts at integration that may produce a more coherent picture of the determinants of human development are already underway among the task force members, and this is most evident in the ways that it has led various members to reflect on their ongoing work. Given the degree of interaction during the task force efforts that were aimed primarily toward developing a proposal, it can be anticipated that thin integrative activity will escalate sharply during the actual program phase.

• The Language of Human Development. As we began our work, we discovered that we needed a common language to talk to each other about human development. Thus, as is often the case, one of our first tasks has been taxonomic. Two factors make this difficult. One is the use of jargon differently across scientific fields, even those that are rather closely related. This is of course a symptom of the very lack of integration that we hope to address. The second factor is that many of the relevant concepts for discussion of these ideas are inevitably, and sometimes heavily, value-laden. In order to proceed, we have tended to develop a common understanding of some key term, recognizing explicitly that values are an inherent feature of any discussion about how we, as humans, live our lives.

Critical Period: Originating in ethology, the strict meaning of this term is a developmental period during which, and during no other developmental period, particular events will have an enduring effect on the organism. During a critical period not long after birth, for example, certain species of ducks will bond with virtually any moving object in the visual field. As this is most often the mother in the natural habitat, the appropriate connection is established. But if this critical period bonding occurs erroneously, it is apparently impossible to disconnect. Another example is the necessity for particular kinds of visual input during critical period of development of the visual cortex, some of which may be measured in hours. Thus, a critical period refers to a fixed time during which certain events have critical impact on development.

A broader meaning of the notion of critical period has also been used. In these cases, the link between a particular experience or exposure and a particular development is not as clear as in the strict cases, but where it makes sense to identify especially salient developmental transitions. The establishment of a secure attachment to a caretaker in the first two years of life is one example; in the absence of such experiences, certain features of social interactions may be different across the individual's lifetime. Less strict versions of critical period in this document has not been reserved to the formal cases.

Economic Growth: A variety of meanings have been attached to this term. One view associates it with expansion, unrestrained development, and accelerated exploitation of the natural environment. A view more compatible with the notion of human development embodied in this proposal associates growth with both the generation of wealth and the appropriate distribution of that wealth to enhance human development in the broad sense. Economic growth that produces too many negative effects on human development is unlikely to be self-sustaining in the future. We would look forward to models of economic growth in which key human developmental factors would be explicitly included.

Human Development: When we use the term human development, we refer simultaneously to ontogenesis (the individual lifespan) and to societal development. The connection between these two kinds of human development is a fundamental theme of the proposed program.

Innovation: Two kinds of innovation play a key role in this proposal. The first is the more common use, namely technical and scientific innovations. Ability to generate these innovations is likely to play a major role in a society's future economic competitiveness, as the wealth-generating capacity of such innovation increases. Societal arrangements that foster the development of a capacity for innovation in the population will become increasingly important.

A second type of innovation is social and institutional. As we consider ways of supporting key developmental needs in modern societies, we may discover that traditional institutional arrangements are inadequate. For example, the ability of schools to meet some of the emerging developmental needs of students, given deep changes in the society at large, may be unduly restricted by their traditional structures. In order to meet new problems, we may need to devise new social forms. In neither case should innovation be understood as change for change's sake. In particular, institutional innovations need to be undertaken cautiously, as the unintended consequences may prove more important than those that were planned.

Learning: We intend here more the colloquial than the technical use of this term. Many years of psychological research on learning have so narrowed the original sense of learning that it is often not appropriate in a broader context. But there is no easily understood alternative term that has the rich colloquial connotations that learning does. Indeed, we are expanding the term beyond even its traditional, common sense usage. In a consideration of the learning society, we are proposing that the notion of learning as a strictly individual acquisition of skill or knowledge needs to be supplemented by a more social sense as well. The ability of groups, organizations, or even populations to demonstrate learning is a key facet of our proposal.

Social Planning: This is a term with such a checkered past that we have avoided it in this document. One view of social planning is highly control-oriented, geared to get society to conform to some preconceived structure. Historically, this has never worked for long, and was overwhelmed by more potent processes -- mostly economic and technological in nature -- whose consequences were rarely foreseen, much less planned. (The automobile is a prime example: It has likely transformed the face of the physical world more than any single previous human-made object, although the scope of this transformation would surely not have been widely anticipated at the time.) When centralized social planning has been applied by the force of the state against these processes, it has had pernicious consequences, as Eastern Europe and the former Soviet Union are painfully aware.

It is in a wholly different sense that we need to understand the notion of societal decision-making. We begin with the recognition that many fundamental policy decisions are made every day in all society's institutions, and that such decisions often have profound effects. Many factors are usually weighed in such decisions, and appropriately so. Too often, however, policy decisions are not considered with regard to their impact on crucial aspects of human development. The remedy to this is a deeper and more widespread understanding of human developmental needs, and of the necessity of including human factors in social policy formation.

1.6 Conclusion

In this overview, we have attempted an initial sketch of what we hope will become a coherent story of the fundamental determinants of human development and the impact of the social environment on that development. We have also indicated the nature of the conceptual framework that would integrate the work of program members. In subsequent sections, we explore in greater detail specific aspects of human development that give rise to this initial portrait, and consider the important scientific advances in a variety of fields that form the basis of such efforts. In so doing, we seek to examine the fundamental aspects of human development, and how broad features of modern societies have an impact on it.

We view the construction of a learning society as a critically important task, and we explore the opportunities and the challenges for doing so. One central challenge is to redefine the relationship between individual and collective development, and to enhance our understanding of their fundamental interdependency. Cultural beliefs and social forms that emphasize one at the expense of the other are not only inconsistent with the best available evidence on human development, but are also unlikely to offer the best opportunity for sustained economic growth and population health.

2.0 Human Development in the Modern Era

The success of any society is a result of the interplay of many forces. Some aspects of human development are fundamentally collective: the rearing of children and their socialization, the generation and distribution of physical necessities, the care of the ill and infirm. The way in which a given society organizes these functions has, in turn, a dramatic impact on the development of its individual members: on the quality of nurturance and education they receive when they are young, on the availability of meaningful and rewarding work for them when they mature, and on their health and well-being throughout their lifespan. These aspects of collective and individual development are mutually causal. Healthy and competent individuals are essential for the fulfilment of critical collective functions. Likewise, the effective functioning of the collective is essential to the healthy development of the individuals who constitute it. In many ways, this is as true of non-human primate groups as it is of human societies.

Understanding this interplay of collective and individual forces is critical when a society is perceived to be facing significant obstacles to success, or when it is undergoing rapid change. Both conditions are evident in the contemporary North American context. The ability to compete in an emerging global economy is likely to be increasingly based on the ability to motivate and organize all members of a society, in an innovative fashion. At present, the burden of suffering arising from poverty and social marginalization is far too great. Not only does this burden decrease the quality of life for those who experience it, but it also absorbs some of the society's scarcest resources in merely maintaining, rather than enhancing, the lives of its individual citizens. Especially its children.

Childhood is a critical period for later development: on this, the accumulating data are overwhelming. To a considerable degree, the intellectual competence, health, and coping skills of any adult all have their roots in his or her early experience. Much of the evidence on the impact of early experience in contemporary society is disconcerting. It suggests that, as a society, we are not coping well with the rapid social changes that are already underway, and probably accelerating. It also suggests that our children will have to bear the brunt of this failure. We must also be concerned about a downward spiral of effects. From one generation to the next, the damaging effects of negative early experience may actually be on the increase.

There is, however, considerable encouragement in the existing developmental data as well. Our understanding of many of the key determinants of human development -- both those that are barriers and those that tend to optimize positive outcomes -- is increasing; not just in its accuracy, but also in its coherence. As our data and understanding improve, so, too, does our ability to rise to the challenge that the data pose. The main objectives of a CIAR program in human development are thus to analyze and integrate existing knowledge on human development and -- more important -- to reconceptualize the dynamics of collective and individual human development from which these data derive.

In pursuing this agenda, we anticipate that significant new research questions will emerge and be explored, including research on how we might more effectively bridge the gap between scientific understanding of development and its practical applications. We also hope that our research effort may help us transform the ways in which we view the fundamental processes of human development, thus affording us a better opportunity for guiding social change away from negative and toward more positive outcomes.

2.1 The Current Dilemma

Modern technological societies require a constant flow of ideas -- scientific discoveries, applications, and inventions -- if they are to maintain their position in the global world economy, and insure that they create sufficient wealth to support a broad range of social, medical, and human services. The creation of new ideas and applications is in turn dependent on the availability of a highly skilled and motivated workforce, and its orchestrated deployment across a broad array of scientific and industrial tasks.

These propositions are axiomatic to the CIAR program in Economic Growth, and closely related to the program in Population Health as well. There is also growing acceptance of these propositions in the business community, and in the body politic. What is not known, however, is exactly how to go about fostering the development of such a workforce. Moreover, there is a serious danger that this problem will be viewed as a purely technical one: to be solved by some relatively simple fix such as "putting more money in the educational system." While our educational system may well be in need of better financing, the problem of developing our human resources to their fullest is a complex and multifaceted one, whose solution will require a far broader perspective than this. Indeed, if we are to get at the root of the problem, we may have to question some of our most fundamental social assumptions. The essential dilemma is this: The same set of forces that have propelled us into the modern era, and increased our dependence on information and knowledge for the production of value, have also weakened the very institutions that have traditionally been most central to the development of our human resources: namely, the family, the school, and the community.

The signs of this dilemma are all around us. We live in an era where family instability is increasingly common, where drug and alcohol abuse have reached alarming proportions in many sectors of society, and where family violence is on the increase. Even in households where none of these situations is apparent, both parents must often work long hours outside the home, simply to make ends meet. The impact of these factors on the family, and thus on our children, has not yet fully been assessed, although initially available data are distressing. As but one example, figures indicate that children are often the ones who must bear the greatest share of the burden that results from poverty. At the same time, the problems associated with large scale immigration, with poverty, and with unemployment are increasing, and placing an increasing burden on our children and on the educational system that serves them.

Finally, with increasing congestion, crime, and violence in our large cities, these areas are losing their ability to engender a sense of community and civic responsibility in their citizens. They are also losing their capacity for supporting an adequate health and welfare system. Further complicating this dilemma is the overdue recognition that, as a society, we need to include previously excluded groups on an equitable basis, particularly indigenous peoples and those from minority cultures. Just as the need of our society for informed, skilled, and compassionate citizens is increasing, then, the actual capacity of our society to meet this need appears to be on the wane.

The project we propose begins in this urgent context. We do not believe that there is an easy solution to any of these problems. Nor do we believe, however, that the problems are the inevitable consequence of life in the modern era. If one takes a cross-national perspective, one discovers that certain societies are adapting far more successfully to the requirements of the information age than are others. Moreover, the societies that appear to be adapting most successfully are those that have historically placed a very high value on learning, and regard it as a lifelong process. Not coincidentally, they are also societies that invest heavily in mothers and children, that have a highly educated work force, and whose social institutions ensure that learning takes place across all social classes, and across the full life span. Rather than experiencing an erosion of the family and other basic social institutions, then, certain modern nations have actually managed to revitalize them, and dedicate themselves to the new and more technical demands of the modern era.

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What we propose to do in the present project is to develop a profile of what "a learning society" must be like, if it is to thrive in the modern era. Our attack on this problem will be three-pronged. (1) We will examine the way in which learning and development are fostered, in societies where the transition to the modern era is being negotiated most successfully. (2) We will examine the barriers to such development that exist in our own society, with special emphasis on factors leading to emotional, behavioral, or academic problems in our children, but with additional emphasis on barriers to continuous learning and development throughout the life span. In addition, critical aspects that lead to successful development within our societal context will also receive special attention. (3) We will consider the problem of getting there from here. That is to say, we will consider the problem of re-vitalizing and/or modifying our own institutions, in a fashion that will more successfully meet the needs of our society across the life span, in a human and humane fashion. Included in this consideration is an explicit recognition that such adaptations may require rethinking the nature of the collective commitment between individuals and the societies that they comprise.

In the remainder of Section 2 (2.2 to 2.6), we outline several examples that illustrate this interplay of social and individual development, which the present program seeks to elucidate. The scientific bases for unrevealing the major questions that arise in these and other examples are the focus of the next section (Section 3).

2.2 Social Supports for Optimizing Competence

How children from an early age gain the basic habits for learning has been shown to differ substantially from nation to nation (Rohlen,1992; Stevenson & Stigler, 1991) and inside versus outside schools in our own society (Lave, 1988). The significance of early learning patterns is that they set the stage for later learning, not just in school but also in adult work situations (Duke, 1988; Rohlen,1989, 1992; Peak, 1991). Anthropological investigation of actual learning patterns in many nations have established the importance of cooperative learning for teaching habits of collective problem solving and improved communication, as well as for increased cognitive achievement (Lewis, 1989; Peak, 1991; Shrage, 1991; Tharp & Gallimore, 1988). Other kinds of successful learning institutions, such as apprenticeship systems, also hold out the promise of new insights and ways to sharpen North American practices and assumptions. In effect, there is today a considerable effort underway to study and compare how learning is encouraged in organizations throughout the industrial world, and this trend is convergent with the anthropological reexamination of successful learning in schools (Amaya, 1990; Cole, 1989; Levitt & March; 1988; Senge, 1990).

Many more examples, some general and others quite specific, could be cited to illustrate this simple fact: the more we learn about how different cultures construct learning environments, the more we come to realize how fixed, limited, and sometimes inadequate our own traditional assumptions may be. By opening the topic of learning to broad reconsideration, then, what contemporary anthropological research has done is to create the opportunity for a new synthesis: one that sees learning as society-wide in significance, and open to serious redesign in terms of basic premises and practices.

This new view challenges the notion that what is missing is merely more money. It also challenges the idea that the individual is the only focus of study, and questions the degree to which schools and classroom instruction are the heart of the process. In effect, the new approach asks whether many fundamental tenets of the Western "folk theory" of learning need to be changed. According to this emerging sociocultural view of development, what we need to foster in our learning environments is not just more excited, independent inquiry (though this is vital, and has its place); nor is just more teacher-centered didactic practice (though this, too, has its role). Rather what we should aim for is developing a "community of learners," linked in a process of increasing engagement, communication and participation in the search for optimal modes of shared intellectual growth and successful patterns of problem solving. We might also hope that our children will come to understand that they are being initiated into "communities of adults" where learning will remain a central and life-long focus.

The implications of this new view extend far beyond the classroom. The individual's approach to learning, and to developmental challenges more generally throughout a lifetime, are likely to be related to early experiences in negotiating developmental tasks (Csikszentmihalyi, 1990). The nature of the child's experience in the home, and during the transition from home to school, establish patterns of social interaction that are likely to endure. Introducing unfamiliar patterns of social interaction in workplace training or re-training, for example, may be difficult if there is no basis in early experience for such practices. What is needed, given the value of this emergent emphasis on the social aspects of learning over the life course, are ideas on how to establish effective practices well suited to our own culture, which will link habits learned early in life with evolving patterns of innovation in our work organizations, where a premium is being placed on improved communication and increased participation in problem solving by all (Brown, 1991).

While it is vital to understand the successes of other countries in this regard, it is just as important to fashion innovative approaches that fit our own circumstances. Communities of learners (or of workers) will be sustained only when they arise from, and are adapted to, our own cultural context.

2.3 The Social Cost of Failure

Defining the preconditions of optimal development serves to highlight the deplorable fact that many children are growing up under conditions that are very harmful. The development of cognitive competence may be hindered by a host of early deprivations, and is often complicated further by a mismatch between the child's acquired learning style and the standard pedagogy and discourse of schools. Failure to develop a healthy pattern of social interactions, and attendant emotional maturity, are likely to have significant impacts on coping and social relational skills in later life. In turn, these are often associated with behaviours that are high risk for the next generation -- such as developmentally early pregnancies that may compromise the health and competence of infants and preschool children.

One particularly well-investigated example of a dysfunctional pattern is that of antisocial behavior. Antisocial behavior in childhood often has its roots in the dynamics of the home. In the Ontario Child Health Study, 5.5% of children 4 to 16 years of age were classified as conduct disordered, that is, they had clinically important levels of antisocial behavior. Children with the disorder have a lowered life quality, which is a result not only of the symptoms but of the associated impairments such as disturbed social relationships and poor school performance. Also, in a significant proportion of children, the onset of antisocial behavior in childhood heralds a lifetime of serious psychological disturbance. For instance, in the Ontario Child Health Study, approximately 60% of children age 8 to 12 who were classified as conduct disordered retained that classification four years later. And in clinic samples, approximately 40% of children or early adolescents with persistent antisocial behavior have serious psychosocial difficulties in adult life, including psychopathy, criminality and alcohol and drug abuse. The societal costs resulting from conduct disorder and its sequelae are thus very high (Offord, Boyle, et al., 1987, 1991, 1992).

Knowledge of the developmental pathways by which antisocial behavior arises is of prime importance if effective intervention programs aimed at lowering the burden of suffering are to be realized, and if the socially marginal life courses of many of these children are to be avoided. One of the developmental pathways that has been well documented (Offord et al., 1992) begins with a preschool child with a difficult temperament, who grows up without encountering consistent parental limits. Upon entering school, such a child often exhibits aggressive patterns of behavior, which lead to a downward spiral of alienation and school failure in the early elementary years. By early adolescence, the child has found a deviant peer group with whom to associate.

Finally, when the antisocial adolescent becomes a father or mother, the whole pattern may then re-cycle. Indeed, one of the best predictors of this developmental pathway is the parent's own personal adjustment before the birth of the child. Youths who have had important social adjustment problems tend to mate with individuals who have also had adjustment problems (Rutter, Quinton, & Hill, 1990); they are at high risk of becoming parents early in life, and of providing less care of their children (Quinton & Rutter, 1988; Serbin et al., 1991). We need to find how to break this intergenerational reproduction of social failure.

It is important to note, however, that the foregoing pattern is not an immutable one. Early developmental stimulation may be a promising avenue for interrupting this negative cycle (Weikart & Schweinhart, in press). Other factors, such as attachment to a supportive adult other than the parents, can mitigate these effects and generate a different developmental pathway (Werner,1989; Werner & Smith, 1992). Much work is needed in refining our knowledge about developmental pathways. Better measures of risk factors and protective factors are needed, as well as better understanding of the dynamic interplay of factors that can transform an unsuccessful developmental trajectory into a successful one, and the "points of leverage" at which such intervention is most likely to be successful.

2.4 Other, Hidden Costs

Even among children for whom no antisocial behavior emerges, there are often other, more hidden, effects of an adverse early social environment. Moreover, these can, in the long run, prove just as devastating for the individual and for society. In a recent series of studies, it has been shown that there is a social class gradient in young children's cognitive functioning that is very similar to the one that has been found in the adult health data (Case et al., in preparation). For example, young children who have grown up in poverty are a full two years behind their more advantaged peers in pre-mathematics skills, by the time they enter kindergarten. This early deficit has a cumulative effect. Since the school system is not set up to deal with these sorts of deficits, and since mathematics serves a "gatekeeping" function in the school system, those who start off this far behind can rarely, if ever, catch up, and thus are effectively barred from full participation in science and other technical subjects. By adolescence, many of these students are very far removed from realistic opportunities to acquire these competencies (Keating, 1990a).

Although the overall pattern is a discouraging one, there is at least a ray of hope here, since preschool programs have been developed which can compensate for at least some of these difficulties, if child care centres are seen as child development centres, and if it is understood that the provision of mathematical games and other similar experience is one important mission of such centres (Case et al., in preparation). Still, there is a problem in staffing such centres, or for that matter the early primary grades, since primary teachers are drawn from the bottom quarter of the population in mathematics skills, in both Canada and the United States.

This general state of affairs is in sharp contrast to the one found in other parts of the world, particularly in Asia. In contemporary Japan, for example, the social class gradient in cognitive "entry skills" does not appear to be nearly as steep to begin with (Sato, 1991). In addition, early math is given a much stronger emphasis, and taught by teachers who are drawn from the top quarter of the population in mathematical competence, not the bottom quarter. The net result for North American society is likely to be a severe competitive disadvantage, with the burden of suffering once again being borne by those who already have the fewest resources. Again, our conclusion is not that we should emulate the Asian model. Rather, it is that by reconceptualizing the nature of learning and the relationship between collective and individual development, we may be able to provide a knowledge base for moving our own society forward.

2.5 Life Courses and Consequences

The effect of early developmental forces is not always simple or direct. Adverse early influences on development may have progressively large, multiplicative effects, or be buffered by subsequent events, such as finding a supportive adult figure other than the primary caretaker. A particularly useful model of this dynamic process emerges from research on non-human primates. In this research, the influences of genetics, social environment, and time have all been taken into account.

Among Rhesus macaques, a subset of offspring consistently show a tendency to react more adversely to stressful situations and to be more passive in novel learning situations than their "normal" counterparts. This tendency seems to be genetically determined, since it expresses itself before the process of socialization can logically be expected to have had an impact. However, experiments that manipulate the quality of familial relations in early life show that this genetic tendency can be largely overcome, by providing the vulnerable monkeys with a very supportive social environment in their first several months of life. By contrast, when the animals grow up in more adverse circumstances, those who seem to be genetically vulnerable end up at the bottom of the social hierarchy in adulthood.

One crucial issue exemplified in this research is the difference between a simple "pathway" and a "latent effects" model. We normally think of human development in terms of sequences of events that occur over time, and that either mitigate or reinforce past circumstances. For instance, child abuse may lead to school failure, which may lead to chronic unemployment, and so on. This may be thought of as a pathway model. It implies that there ought to be intervention points along the way that can significantly alter outcomes, and stresses the fundamental importance of such intervention opportunities, in order to shape subsequent development.

The latent effects model is different. It is based on the idea that critical events that happen at specific times in life may influence outcomes years or decades later on, regardless of the intervening circumstances. One example of such an effect would be the fact that exposure to most environmental carcinogens leads to excess risk of cancer no less than ten years after the first exposure, regardless of intervening circumstances. In the extreme, there have been reported instances of early life exposure to asbestos which have resulted in mesothelioma sixty or more years later. Moderately high lead exposures by age seven may reduce the probability of someone graduating from high school, even if subsequent exposure to lead were quite minimal.

This observation is compatible with the notion that the developing brain has critical periods during which it is particularly sensitive to specific experiences, stressors, or injury. For example, it is known that in the absence of specific sensory information at specific times during development there will be permanent abnormalities in cortical development. The effect of such abnormalities may only be apparent in abnormal cognitive function observed years later. Similarly, even relatively subtle cerebral injuries at certain times early in life will lead to radical abnormalities in subsequent brain organization that may not be apparent behaviourially until adolescence.

In isolation, then, both the pathway and the latent effects models have weaknesses. Uncritical acceptance of a pathway model can lead to short term thinking about the determinants of well-being and an overemphasis on the process details. Overreliance on the latent effects models leads to the seeking of "magic bullets" that, if applied at critical times, are assumed to inoculate the individual from the possibility of negative outcomes. It also leads to the tendency to lay blame at the feet of principal caretakers. Yet these two models may be powerfully complementary in unravelling the often confusingly complex patterns of human development.

In extended studies of non-human primates, several of these patterns emerge with considerable clarity. First, different sets of early social experiences among macaques can be linked to specific behavioral and physiological propensities expressed later in life. The more deviant the early experiences are, the more extreme are the long-term consequences. In particular, the quality of early attachment relationships seem especially crucial for subsequent development of coping skills. Second, these long-term consequences are more likely to be expressed under conditions of novelty or challenge than in the absence of stress. Indeed, in relatively stable and benign environments, adverse early experiences may have no discernible long-term consequences; thus, the effects are masked. Finally, the consequences of specific early social experiences may not be the same for all individuals. Instead, some individuals, due perhaps to heritable predispositions, may be far more sensitive to the effects of early social experiences (Suomi, 1991a).

Subsequent examples will elaborate on this theme of attempting to resolve complexity through simultaneous attention to the regularity of population effects, the ubiquity of individual deviations within those broad gradients, and the multiplicity of developmental processes that give rise to these patterns. The ability to move between data structures, or "marker"-type analyses, and process-oriented, dynamic analyses will be an essential ingredient of the human development project.

2.6 Utilizing Life Expertise for Social Development

One of the historical ironies in the formal study of human development is that the focus on identifiable stages of development diverted attention from the continuity of development across the life span. This relative inattention to integration within an individual's development has been mirrored at a societal level, at least in North America, in an increasing age segregation and a consequent specialization of socialization functions. Nowhere is this unfortunate irony more evident than in the failure to make use of the accumulated talents and wisdom of the older generation for inspiring and providing structure for the younger one.

In several of the examples already cited, a key protective factor for children in stressful circumstances is the availability of a supportive adult figure other than the primary caretaker. The need for such supports seems to be increasing sharply, as a result of economic pressures for dual-earning families, the increasing ratio of single-parent families, and the insufficiency of high-quality day care arrangements. At the same time, many older adults, retired from employment and/or from direct child care responsibilities, suffer from social isolation and a need to be more involved in meaningful activities. The historical pattern of age-integrated extended families living in close geographic proximity tended to ameliorate both problems to some extent, offering supportive, non-parental adult figures to the young and meaningful socialization activities for older adults. The social changes in the modern era have inadvertently disrupted this pattern, likely to the developmental detriment of the individuals and to society in general.

It is not only in direct child care that such anomalies arise. In the workplace, individuals who have acquired considerable expertise that would be valuable to the success of the enterprise are routinely separated from that community involuntarily. These patterns are not just a function of economic pressures, but also of rigid practices that create an artificial barrier between full employment and total retirement.

Other examples could be generated, but the general point is clear. To the extent that contemporary social arrangements enforce age segregation and fail to make use of the energy and the accumulated expertise and wisdom (Baltes & Smith, 1990) of the older generation, both individual and collective human development suffer. Available evidence -- for example, from experimental "mentoring" projects (Freedman, 1988, 1991) -- suggests that older adults would likely benefit from the opportunity for socially meaningful use of their talents, including cognitive and health benefits from continued, active, and challenging engagement with the world. Succeeding generations would clearly benefit from such interactions, and in many cases display an evident need for just such expertise.

Detailing the value to society of this process of feedback between generations requires careful study, but it is likely to be great. This issue illustrates succinctly two key arguments of the human development project: first, the critical nature of feedback functions between individual and collective development; and second, the inadvertent negative outcomes arising from social changes that, taken individually, are progressive (such as employment opportunities for women, or dignified retirement choices for older adults), but in concert create unintended, but not necessarily unforeseeable, difficulties.

2.7 Summary

In the course of our research, we anticipate that we may well have to develop a fresh vision of the process of learning itself, as the examples just described would suggest. The approach we will take to the development of this vision will be interdisciplinary. It will focus on the issue of how human beings learn, not just as individuals, but as members of broader social groups.

In the past, there has been a tendency for learning to be studied primarily at the level of the individual. There has also been a tendency to assume that the process of development is one which is completed during the years of most rapid physical growth. As a consequence, theories of learning have been thought to be the exclusive province of psychology, and/or child development. In the present project, we intend to question both these assumptions, and to cast our net much more widely. Our portrait of the learning society will focus not just on children, but on the entire lifespan, not just on the home or the school, but also on the workplace and the society at large. Likewise, the fields from which we will draw to sketch this portrait will include not just psychology and child development, but a variety of disciplines of the human sciences, such as education, sociology, anthropology, primatology, neurobiology, and information science.

As recently as fifteen years ago, an interdisciplinary effort of this scope would have had little chance of success. At best, it would have generated some vague form of futuristic prophecy. Recent advances in the fields noted above, however, hold out the promise that we can make real progress: both in specifying the details of the learning process in the individual (including its neurobiological, cognitive and social aspects), and in characterizing the conditions under which entire populations can either learn and develop more effectively, or fail to do so. As a result of our integrative effort, we hope that new insights and strategies will be discovered for improving the capacity for learning throughout our society, and that we will be able to make suggestions for policy that are informed both by the pressing situation in which we find ourselves in Canada, and the experience of other countries.

3.0 Pertinent Developments in the Human Sciences

As hinted above, our desire to create a new portrait of a "learning society" is not driven just by a concern with our decreasing ability to compete in the global economy, or our increasing difficulty in dealing with our most pressing social, medical, and welfare problems. Nor is it driven just by a concern for the effect of such problems on our children, as dire as these may be. Our desire to embark on a project of this scope is also driven by the belief that this is a time of remarkable opportunity for addressing these problems in a powerful and integrated fashion.

During the last 20 years, the same set of events that has transformed our economic and social landscape has also transformed our intellectual landscape. Fields of knowledge that did not exist 20 years ago are now thriving enterprises, and several fields that did exist 20 years ago are barely recognizable today.

Many of these developments have occurred as a result of linkages between adjacent levels of analysis. Bridges have begun to be built between the detailed social interactions related to mother-infant attachment in the family and subsequent social outcomes, between neuroscience and cognitive science, between cognitive development and educational practices, and between the study of specific instructional practices and the sociocultural context in which they are embedded. An important facet of the portrait we propose to create is the building of linkages among these existing integrations, in order to grasp both the complexity and the coherence of human development.

In this section, we outline a few of the new developments that we see as most promising and most relevant to this enterprise. Then, in the section that follows, we outline our plan for exploiting these developments, and building a model of the way in which a learning society can function under more optimal conditions.

3.1 Cultures of Learning and Development

The study of learning in this century has long been a monopoly of psychology, which originated in Wundt's laboratory in Germany, and was transplanted to North America between the wars. This has meant that the individual was the focus, and that Western institutions and ideas were the assumed starting place. Recently, anthropologists and others have begun intensive examination of learning in other modern societies. What they are discovering raises a significant set of new questions, particularly with regard to many time-honoured assumptions in the West. Using ethnographic tools for close observation of actual learning situations, coupled with the field's traditional interest in how people of other cultures conceptualize what they do, anthropologists are developing a broader context for the study of learning, one that does not take for granted Western assumptions about schooling and learning. While this methodology is designed more for discovery than empirical validation, those who have used it have already illustrated the need to reexamine many of our most fundamental assumptions about what constitutes an optimal learning environment. They have shown, for example, that using very different methods, the Japanese and Chinese have attained much higher levels of math and science achievement than have North Americans (Stevenson, 1991).

The fresh perspectives generated by such fine-grained comparative research have challenged the underlying assumptions of Western educational thought, especially as it operates in schools. The popular assumption that imitation and rote learning are detrimental to creativity, for example, is open to challenge on the basis of comparative examples. An equally significant reconsideration concerns the importance of cooperative learning, and the place of learning outside the school setting and after school ends (Rohlen, 1992). An orientation to continuous learning, for example, has played an important role in the success of quality circles, job rotation practices, and the total quality movement in factories (Cole, 1989; Kolke, 1990; Stern, 1988).

In the new view that is emerging, learning can be effectively studied in a context (knowledge acquisition, diffusion, and invention) that makes all problem solving activities amenable to a common framework of analysis, one that can have both individual and social components. In combination with other approaches that focus on children's development prior to school, then, these new perspectives have the potential of providing a fresh conceptualization of the learning process. The new work also opens up the possibility of learning from the best practices from a variety of advanced industrial societies.

It is obvious that societies differ in the degree of diversity of their populations. This affects the overall character of institutions of learning. That all must learn may not imply that all must learn in the same way (Keating, 1991b). Furthermore, the degree of heterogeneity of results also needs to be evaluated in the broad context of each society's cultural and demographic character. The adaptation of programs for immigrant, minority, and indigenous populations, the reconceptualization of learning in terms of multicultural goals and realities are important aspects of this comparative perspective. In this regard, it is also important to recognize the historically dysfunctional aspects of the relationship between the mainstream and other cultures (Hunter & Calihoo, 1991). From these perspectives, the diversity of cultural experiences within a single society can be seen as resources for exploring the range of possible connections between individual and collective development.

As learning becomes an increasingly central focus of the comparative study of advanced societies, a crucial question arises as to how learning is valued and conceptualized in different cultures. The heritage of attitudes combined with the redefinition of learning in and by contemporary institutions and authorities, establish a profoundly influential milieu for the constant decisions at all levels of society that shape the dynamics and efficacy of efforts to develop human resources. We intend to examine the role of culture -- how it defines human development, for example, and how it shapes schools, work organizations, and government policies toward families, children, and education. In other words, we see the recognition of the learning society as a process of conscious examination of our own most basic "beliefs" about who we are as learners, what potentials we have, what causes us to learn, for what reasons, and for what part of our lives.

3.2 Attachment Theory, and Its Utilization in Primate Research

Over the past 30 years, important developments have also taken place in our understanding of children's affective and social dispositions toward learning and novelty within as well as across cultures. A major factor contributing to these changes has been the development of attachment theory. The first version of attachment theory was proposed by Bowlby in the 1960's. Bowlby spelled out the vital survival role for any developing primate of his attachment to his primary caretaker. He also spelled out the developmental phases through which this attachment proceeds. Bowlby's theory was expanded by Ainsworth, who documented stable individual differences in the forms of attachment, and the differing sense of security that resulted. Her hypothesized contrast between securely attached babies and insecurely attached babies has since received confirmation across many cultures in humans, and across many other primate species. Infants' status has also been related to the form of parenting they receive and to their subsequent coping skill. Finally, a new form of attachment category (disorganized) has been identified, and related both to abusive early rearing conditions, and subsequently expressed pathology (Main, 1990).

Interestingly, these processes also appear to operate across generations. A mother's account of her own early childhood experiences predicts relatively little about her own child rearing behavior. But when combined with an account of her feelings about her own child rearing experience, and the extent to which she has come to terms with those feelings, it predicts her subsequent behavior with her own infants quite well (Main, 1990). We are thus beginning to get a sense of the way in which the intergenerational process may operate.

These data are important in their own right. However, they assume an added importance because of the way in which they permit animal studies of early development and human studies to be integrated. As it turns out, patterns of attachment in homo sapiens and in higher non-human primates are very similar, as are intergenerational patterns (Suomi,1991b). The Rhesus macaque is a species that has been studied with particular care, since it is one that has thrived throughout the world, and does well in experimental rearing conditions. In the macaque, the stages of early cognitive and social development proceed much more rapidly (approximately 4 to 5 times faster, on the average), but the phases of attachment, and individual differences in attachment styles, appear virtually identical. This has permitted investigators to examine the effects of early rearing conditions in a very precise manner.

Generalization from non-human primates to the human condition always demands caution, of course, but particularly informative models can be derived from Old World monkeys (such as the rhesus), among whom the degree of genetic overlap with humans ranges from 90% to 98+% (among chimpanzees). In addition, most species of advanced non-human primates living in nature reside in complex social groups characterized by long-term relationships among individuals, well-established multigenerational kinship lines, and dynamic dominance hierarchies that reflect both cooperation and competition (Suomi, Rasmussen, & Higley, in press).

A set of findings from the primate research noted above that are of particular importance to the present project are these which show that certain temperamental conditions -- namely those that make an infant fearful in novel situations -- can be overcome if an infant macaque is reared by, and becomes securely attached to, a warm and consistent mother. Interestingly, however, this same fear of novelty can be re-induced, when the organism is under stress in adulthood. The action of protective or "buffer" factors can thus be experimentally manipulated (Suomi, 1991a).

In human studies, the effect of a range of early risk and buffering or protective factors is also under investigation using longitudinal and epidemiological methods (Achenbach et al., 1991; Offord et al., 1992; Werner, 1989; Werner & Smith, 1992). The interplay between human and animal models provides an opportunity for more precise examination of putative causal influences. It also offers particular opportunities for exploring the dynamic interactions among biological and behavioral factors affecting health and well-being, and for understanding the affective underpinnings of the different learning styles that different cultures engender.

3.3 Family Sociology and Behavioral Epidemiology

Whatever its form and structure, the family is still the first and foremost context in which early human development takes place, in most developed countries. This is particularly so during pregnancy, infancy, and early childhood, when the mother-infant dyad is being formed, and exerting its strongest influence. Pre-and postnatal maternal interactions, the competence of the newborn, and the "empowerment" of the young mother and father are thus crucial for successful development, and the way in which this empowerment can be optimized constitutes a major field of research: one where the fields already mentioned so far (anthropology, psychology, and primatology) and other fields (such as sociology and education) must meet.

Later on in the life cycle, the child's primary socialization takes place in a more varied set of contexts, and the peer culture assumes a major role. Thus, a key issue becomes how to continue an optimal developmental trajectory as children move in and out of the multiple social contexts in which their lives are lived (Bronfenbrenner & Crouter, 1983). Still, for early development, the family remains paramount. Thus, studying those families who succeed, in spite of the sorts of adverse conditions that have already been alluded to, becomes a subject of great importance, as does the integration of available data on families where some form of failure is evident.

One such cycle has already been noted, the development of antisocial behavior, and can best be depicted as occurring in three stages. In Stage 1, the preschool years, the essential ingredients are (1) a temperamentally difficult child who is aggressive and stubborn, (2) a parent (usually the mother) who, for a variety of reasons including high levels of stress, can not effectively discipline or place reasonable consistent limits on the child's behavior. (In fact, her efforts to discipline the child make things worse, engaging in what has been termed coercive interactions with the child, leading to such discouragement that the mother often withdraws from the child). (3) a father who is absent or who is a model of erratic or aggressive behavior may also be a contributing problem. Finally, the entire problem may be exacerbated by economic disadvantages and the culture that has evolved to cope with these circumstances.

In Stage 2, the early school years, the problems multiply for many of these children. (1) First, they enter school with aggressive behavior patterns and with poor prospects for academic success. (2) Second, their early school experiences typically include fighting with peers and teachers, as well as with parents, and school failure. (3) Third, these lead to alienation, low self esteem, and association with peers displaying similar developmental profiles.

In Stage 3, early adolescence, the combination of alienation from the mainstream culture and continual contact with a deviant peer group leads to serious antisocial behavior which can result in juvenile delinquency.

These sorts of investigation have just recently begun to receive the attention they deserve. Until recently, the sociology of the family has not been considered as a subfield, per se, but has been studied in a rather piecemeal fashion. Nevertheless, a corpus of knowledge has gradually accumulated. This has recently been summarized in a French volume by Francois de Singley (1991). One area of importance that emerges from his summary is the sharing of child rearing duties, not just within a single family, but across families and also between individual families and the broader culture. This subject is one that fits well to a broader theme of our project, namely, that the development of the individual can not be understood independently from the development of the group.

A similar point can be made with regard to intrafamilial violence. This is another area of considerable importance, which has received a good deal of attention in recent years, and in which local family and broader societal forces interact. This topic will be a subject of study in the present project primarily through the work of our program associates, both locally and in Europe. Again, the life-span consequences of intrafamilial violence involving children are of considerable importance, and emerging research will further clarify this picture (Starr, MacLean, & Keating, 1991).

3.4 Cognitive Science

So far we have spoken primarily about changes in our understanding of social variables and of early social experiences. Important changes have also taken place, however, in our understanding of cognition.

As recently as twenty-five years ago, intelligence and creativity were both thought of as individual traits, which any given child had a lot of, a little of, or some specifiable amount in between. The debates of the day concerned such issues as whether these traits were innate or learned, unitary or multiple, fixed or amenable to change. During the last decade, there has been a revolution in the way in which intelligence has come to be viewed, and in the technology that has been developed for modelling it. A new discipline entitled "cognitive science" has emerged, which takes the digital computer, and the artificial intelligence with which it can be endowed, as models for the nature of the human cognitive system. The digital computer has also emerged as a tool which can be used to evaluate the nature of human intellectual functioning, and which can play an interactive role in fostering its development.

During the first wave of the new cognitive research, people began to think of the human cognitive system as one which must process information efficiently, in order to come to optimal decisions in novel environments. More recently, investigators have begun to examine the properties of the symbolic systems with which computers must be equipped, and the massive data structures to which they must have access, if they are to function in an intelligent manner. The importance of having a huge number of small data structures which can function in parallel is just beginning to be understood, as is the role of informal knowledge, and the manner in which such properties as "coherence" are computed within and across data structures that represent this informal knowledge -- and the vital role that they play in determining the reliability of any newly proposed way of organizing information (Thagard,1989).

Another promising line of work concerns the importance of powerful schemata which function as prototypes for organizing new data, and connecting them to previous data in a productive fashion (Catrambone & Holyoak, 1989). The long term prognosis is for a fundamental re-structuring in our understanding of what is entailed by intelligence and creativity, and the way in which such variables as "deep" knowledge of a field, or "intuitive reasoning" within it, should be conceptualized, along with the importance of informal knowledge whose roots may be traced back to early childhood. Among the likely outcomes of this reconceptualization is a better understanding of the magnitude of knowledge that underlies expertise, and a more thorough grasp of the distance between traditional formalisms regarding learning and what actually happens during learning and development.

3.5 Cognitive Development

As the above changes have taken place in cognitive science, a corresponding set of developments has begun to take place in the field of cognitive development. During the first wave of the new cognitive research, the mental characteristics whose development were studied in young children included (1) the size of the peripheral channels by means of which children receive information from the world around them, (2) the capacity of the buffer in which they store this information for brief periods of time, and (3) the nature of the heuristics they use in accessing, retrieving, and operating on related information in an efficient manner (Case, 1985; Keating & Bobbitt, 1978; Klahr,1989; Siegler, 1978).

More recently, investigators have begun to explore the nature of children's developing knowledge structures (Chi,1988; Carey,1985). One of the most promising discoveries has been the existence of central conceptual structures (Case, 1992). These are deep conceptual structures, with a broad range of surface applications, that are acquired at certain key periods in children's growth. Once acquired, they permit children to take advantage of scholastic or other environmental opportunities that are offered, at a new level. Conversely, if they are not fully consolidated prior to the exposure to such opportunities, they may prevent children from taking full advantage of the opportunities they do receive. In effect, they may serve a "gating" function.

One such structure is the one involved in proportional reasoning. Proportional reasoning plays a critical role in almost all areas of science, and also mathematics. Yet there is good evidence that this structure fails to develop in at least 50% of our adult population and that -- when absent -- the structure plays a role in preventing students from profiting from subsequent instruction in science and mathematics (Keating, 1980, 1990a). As a result of the structure's demonstrated importance, intensive efforts are currently underway to probe its internal structure (Case, Krohn, & Bushey, in preparation; Greeno, in press; Keating, in press), and to determine what barriers contribute to its failure to develop under present conditions. One barrier that has already been identified is that insufficient attention is given to the integration of intuitive understanding and algebraic algorithms (Keating & Crane, 1990). Under conditions where this barrier is removed, development seems to proceed much more smoothly (Case & Sandieson, 1988).

Another barrier that has been identified -- particularly in North America -- involves the subtle feedback loop that was mentioned in the introduction. In contrast to the situation in Asian countries, where elementary school teachers are drawn from those who score in the top quartile in mathematics, in North America they are drawn from the bottom quartile. Very often, as a result, they do not fully understand the sort of proportional reasoning they are asked to teach. Once again, then, we see the importance of understanding that our current problems have multiple causes, in which social and cognitive factors are intimately interwoven.

Clearly, cognitive development does not stop at adolescence, and an important area of research concerns the changes after adolescence in a wide range of cognitive activities. In general, cognitive abilities decline somewhat during adulthood, and rather more precipitously after age 60-70, but patterns vary enormously, depending on the specific cognitive ability and on the individual. The analysis of cognitive changes in adulthood and aging is an active endeavour (Craik & Salthouse, 1992), but much remains to be done. In particular, the early life antecedents that determine or influence later cognitive performance are poorly understood. Are there early critical experiences or critical periods that foster or inhibit later achievement or continued cognitive vitality into adulthood?

The importance of these issues in a societal context of shifting age demographics is evident. Two aspects deserve special mention. Retraining in mid-career has become widespread in today's rapidly changing workplace, yet the factors underlying the optimization of learning in adults, especially older adults, are not well researched. What is known is that there is striking variability in performance levels among elderly people; some are equal to the best young subjects, whereas others perform far less well. What are the factors that determine a specific person's intellectual powers in older adulthood? To what extent are the maintenance of high levels of cognitive performance and the ability to respond to novel challenges determined by antecedent developments? What are the conditions that optimize the possibility of new learning, and how do they differ across persons? And, given the increasing importance of continuous learning and collegial involvement in the workplace as an engine for innovation (Brown, 1991), what are the critical experiences during early development and in educational settings that prepare adults for these cooperative activities? There is great potential value of an integrated, interdisciplinary life-span approach for addressing these and related questions.

3.6 Critical Trends in Educational Thought

The foregoing section leads naturally to a discussion of educational practice. Educational practices in Canada are determined by provincial and municipal authorities, not by some national body. This fact notwithstanding, it is possible to identify at least one debate which surfaced from coast to coast during the 60's and 70's, and two promising new developments that have taken place in recent years, which offer a potential resolution to this debate.

The major tension that emerged in the sixties and seventies stemmed from a conflict between educational "conservatives" and "progressives" concerning the means and ends of education. At the risk of oversimplifying a complex issue, the "conservative" group tended to see knowledge as a set of concepts and skills which were external to the child, and which should be taught to children in a carefully structured, didactic fashion. After this had been done, it was believed that objective assessment should be undertaken, in order to ensure educational "accountability". By contrast, the "progressive" group tended to view knowledge as originating in the constructive activity of the child, and thus saw the challenge of education as one of stimulating the child's natural curiosity, creativity, and inquiry, so that he/she would develop more powerful skills of inquiry and emerge as a more flexible, thoughtful, and knowledgeable adult.

Of course, most teachers, schools, and school districts adopted a position that was somewhere in the middle between these two poles. Still, there were those that had a strong bias toward one end of the spectrum or the other, and there was a discernible swing in the pendulum from the progressive to the conservative pole, as the 60's gave way to the 70's and 80's.

What has happened in the last few years is that many educators have begun to realize the potential of a third view on knowledge acquisition, both in its own right, and as a potential resolution to the earlier debate. Although not entirely new -- its psychological roots are in the developmental theory proposed by Vygotsky in the thirties -- this "third view" proposes that knowledge can not be understood simply as a static body of external concepts or skills. Nor can it be viewed exclusively as a creation of the child. Rather it must be seen as a organismic entity in its own right, which originates in the development of the culture. What happens in the course of children's development, according to this view, is that children's natural exploration and curiosity leads them into linguistic interactions with peers and adults, whose form gradually becomes internalized as a powerful instrument for further inquiry. When such interactions are attuned to the level of the developing child (in Vygotsky's term, "in the zone of proximal development"), the probability of developmental progress is distinctly enhanced, emphasizing again the fundamental interplay between social interaction and individual development.

Nowhere is the influence of this view more apparent than in the innovative procedures for teaching mathematics that are currently being developed, both on this continent and in Europe. Whereas previous reforms stressed getting away from an emphasis on rote procedures, and introducing concrete manipulatives such as Cuisinaire rods (and counter-reforms emphasized that the "basics" should not be lost in this process), the current reform movement focuses on getting children to become literate in the language of mathematics. It also emphasizes helping children to communicate their mathematical ideas to each other, realizing that many different methods are often possible to solve one problem, and that weighing the advantages and disadvantages of any one method (as well as the discovery of new methods) in small group discussion is a powerful method for deeper conceptual understanding.

The parallel of these methods to those used in mathematics education in Japan will no doubt be apparent. The benefits are not restricted to mathematics, however, as the opportunity for extended, meaningful, and coherent discourse among teachers and students in social studies appears to exert a strong impact on students' subsequent abilities to generate and evaluate complex arguments (Newmann,1990).

3.7 Neuroscience and Development

It is tempting to think of the dynamic interplay between a growing set of cognitive structures, the social institutions in which these structures are acquired, and an individual's affective disposition toward these institutions and structures, as taking place purely at the level of cultural "software," in a biological system whose "hardware" is genetically fixed. In fact, of course, the software is being created in a living system, whose capabilities and dispositions are developing biologically at the same time as they are developing behaviourially. The final important development that has taken place in recent years is the rise of the new discipline that is called "neuroscience," whose province is the study of such biologically regulated change.

During the past two decades, enormous strides have been made in our understanding of the mechanisms that underlie cortical development. One particularly interesting aspect of cortical development is that the brain overproduces neurons, possibly by a factor of two, and the extra cells and their connections are lost in childhood by a process of cell death, which may continue until as late as 16 years of age. This cell loss is not random and is affected by environmental events such as sensory stimulation, social and other environmental conditions, and hormones. Thus, the experiences of childhood can have a significant effect upon the formation of the adult brain and adult behaviours.

Some of these effects may be straightforward whereas others are more subtle. For example, children who suffer from otitis will have impaired hearing, which may subsequently lead to slow language acquisition, and a general impairment of language skills. Thus, the peripheral abnormality may later have a profound effect upon cognitive functioning. Similarly, children who are exposed to environmental stresses or toxins may have an alteration in brain growth, which subsequently changes the way they interact with their environment, which, in turn, affects the normal process of cortical development and cell death. As a result, as adolescents or adults they may show significant behavioral abnormalities that are much greater than would have been predicted from the neural changes seen in infancy. In sum, it has become clear that experiences of childhood can have major, and previously unsuspected, effects upon later behavior, including not only sensory functions but also higher order cognitive functions upon which the acquisition of technical and social knowledge is dependent.

Recently, developmental studies have moved beyond descriptions of the effects of abnormal development to the systematic study of the manner in which cortical development is dependent upon the coordinated expression of a variety of neural elements in an intricate spatial and temporal progression. It is also becoming clear that the brain is particularly sensitive to environmental events at particular times, and markers are being developed that will enable us to identify these sensitive periods and those factors that most influence them. Parallel to the development of these markers in nonhuman subjects has been the development of methods for evaluating higher cortical functioning in humans, using such methods as MRI- and PET-scanning. By combining basic studies of cerebral development with information on the functioning of the cerebrum in normal and pathological states, we may ultimately reach the point where we can present individuals with an optimal environment both for normal brain development but also with particular sorts of corrective or "enriching" experiences during particularly sensitive periods.

Using the foregoing sort of technology, it may prove possible to open the door for applications such as early compensation for particular negative experiences or the absence of positive ones, and which may improve individuals' capacities for learning and open the door for retraining of older individuals. It may also prove possible to examine the different ways in which different societies work within the biological constraints that are their common human heritage, and exploit the possibilities of particular sensitive periods with new and growth inducing environmental challenges.

3.8 The Impact of New Technologies on Human Development

To this point in the proposal, our principal focus has been on changes that have affected patterns of social interaction (in attachment, in education, between generations, and so on). Less emphasized but equally important is that many of these social changes are linked, directly or indirectly, to changes in technology. A key theme of this project that is shared with the program in economic growth is that future competitiveness is likely to be driven by a society's success in innovation, much of which will be technological in nature. The development of new technologies creates new opportunities as well as new challenges for socialization. Both deliberate attempts to use technology to advantage in formal socialization (that is, education and training) and the effects of emerging technologies (such as television or personal computers) on socialization more generally, whether intended or not, form an important part of the picture of human development in modern societies.

A rather exciting educational development that is taking place, on this continent more rapidly than in Europe or Asia, is that third and fourth generation computer technology is being developed which can offer children entry into new "microworlds" (or even more interactive "virtual realities"), and provide new ways for them to conceptualize, represent, and operate on their social and physical world. In at least three locations (Stanford, Berkeley and Toronto), these technological developments are being linked to the developments in cooperative learning. Systems are now being developed by means of which children can become more aware of their own new knowledge (including its strengths and its lacunae) and more capable of sharing their knowledge with others, by being linked together in what have been termed "computer supported networks for intentional learning" (Scardamalia, Bereiter, et al., 1989).

In a similar vein, Papert's group at MIT has continued to develop the LOGO language system that gives even young children access to elementary computer programming in a way that builds on their own motor movements in space. Recently, LOGO has been linked with LEGO in a synergistic way so that ten-year-olds are building rather sophisticated robots in interactive play situations. We are also beginning to see a new generation of software, such as SIMCITY (where urban planning principles are embedded in a user-controlled simulation), that integrate game formats and interactive procedures to convey complex ideas. In the present project, we expect to address the efficacy of these new technological advances, as supports for our evolving conception of optimal learning throughout the life span.

The impact of emerging technologies on human development in circumstances that are less formally planned is a related concern. The evidence on the amount of time that North American children and adolescents spend watching television has been one continuing source of concern for some time (Keating, 1990a). Much of the research has focused on the connection between media violence and behavioral aggression, and tended to support it empirically, but we know much less about the potentially more pervasive effects on perceptual and cognitive habits, or on patterns of family or peer interaction (Williams, 1986). Given the potent but unintended effects of other social changes mentioned in this proposal, it behooves us to attend to activities that were virtually unknown a generation ago but that so strongly dominate the current experiences of today's children and adolescents.

3.9 Summary

Over the past twenty years, a series of exciting developments has taken place in a variety of fields that offer the potential for expanding our understanding of human learning and development, and supporting innovations in the social institutions that are responsible for fostering this development from birth throughout adulthood. Each of the fields of study that has been mentioned offers its own unique contribution, yet at the same time certain common themes may be identified across them.

At the same time that anthropology has been providing new insights into the dependence of learning on societal institutions, and on the experiences that organize the forms of children's learning from the earliest stages of their development, models have been developed in psychiatry and primatology that elucidate the dependence of social forms of learning -- and social coping more generally -- on underlying affective dispositions which have their roots in early attachment relations. Also in parallel with these developments, family sociology and family systems theory have been making great strides. The field of education has been experimenting with techniques that depend more strongly on social forms of organization as well, and which utilize new forms of technology for facilitating children's intellectual growth.

Similarly, at the same time as the discipline of cognitive science has been providing new models of knowledge and its utilization, the study of cognitive development has been providing new models regarding which knowledge structures are most crucial in children's development and throughout the lifespan. Simultaneously, neuroscience has been providing a map of the neurological architecture on which these structures are dependent, as well as the sensitive periods that exist in their growth.

4.0 The Developmental Method: Prospects for Integration

All the developments that were mentioned in the previous section suggest the need for a view of development that is at once much broader and more interactive than was previously entertained, and that spans the full range from biology to culture, as well as the full life cycle. Such investigation was possible earlier. However, the various disciplines were not ripe for integration, and, just as importantly, the technology for effecting such an integration was not well developed. Today, there are complex conceptual and analytic tools available. In the present section, we review one final advance of relevance to the present proposal, namely, the development of dynamic systems theory.

The first assumption underlying dynamic systems theory is that the underlying functions in any system need not be linear, but may instead be composed of higher order functions, which are interconnected. Another feature of dynamic systems theory, one that is particularly relevant to the study of the determinants of human development and learning, is that iterative feedback functions (IFF's) often fuel a system's development. An IFF is described as a function in which the output of a prior iteration becomes the input of subsequent iterations. It has been discovered, both mathematically and in a variety of substantive applications, that elegant structures can be generated through these IFF's. A consequence of this discovery for the study of human development is that the often sterile debate between biological and environmental causes, nature versus nurture, may be recast in a more fruitful way (Rutter, 1991). It is not necessary to seek an a priori design as the explanation for the existence of a structure. Rather, the sensitive and often non-linear interplay among biological features (internal constraints) and environmental experiences (external constraints) may be viewed as an ongoing process.

This is not to say, of course, that all effects are constantly in flux. Many important developments assume reasonably stable "attractor" states, and the inertia of such states is as important a part of the developmental picture as are the processes of change and discontinuity.

A final important feature of dynamic systems is that they are "self-organizing". Hence, the impact of a given event on a developing system is never entirely predictable, in that the specific configuration of internal and external constraints that operates at the time the event occurs will significantly influence its effects. However, at least in the short term, the impact can often be simulated, if a sufficiently rich data base is available. Because dynamic systems are so sensitive to the point in time at which a particular event occurs, progressively complex effects may often follow each other in a cascading fashion. If one imagines a system in which a complex web of variables are connected to some but not all other variables, and some change takes place in this system at an early point in time, one has a sense of the interactive complexity that dynamic systems are capable of yielding.

It is the capability of dealing with this sort of complexity that has enabled researchers to model such phenomena as are found in ecosystems, or in large and potentially turbulent air masses, where a mathematical explication now becomes possible of why certain points (e. g., the "eye of a hurricane") are stable ones, even in the presence of immense flux, and why such points serve to "attract" anything that is changing around them for a wide distance.

This sort of modelling is only just beginning to be applied to development, but already has offered a change in our ability to conceptualize and to model the developmental process in a dynamic fashion (e.g., Keating, 1990c; Senge, 1991; Thelen & Ulrich, 1991; van Geert, 1991). Although many questions regarding the origins and determinants of human development are of long standing, we are only now, with the emergence of this new theoretical tool, coming to understand why our approaches to those questions were previously inadequate.

For example, the potency of a given feature of early development has frequently been evaluated in terms of its direct effect on some later development. Such predictions over long time periods are usually too small to be noticed, and are hence dismissed. A recognition of the contingent nature of such predictions -- a key feature of dynamic systems models -- alters the picture both conceptually and analytically. Differences among children in their earliest relationships with their primary caretakers may predispose them to more or less competence in the future, to be sure. But it is vital to note that such early differences may have progressively large, multiplicative, effects. It is also important to note that such predispositions can be altered by subsequent events, such as finding a supportive adult figure other than the primary caretaker. Finally, an even more subtle finding, namely that demonstrated in the primate literature, can also be understood and modelled. In the example noted above (Section 2.5), the long term prediction from the quality of the early social relationship will diminish, but the importance of that earlier process may remain high for altered environmental circumstances. Thus, one crucial feature of dynamic systems analysis is the move from purely marker variable toward underlying process models, and the ability to deal with "masked" effects. Indeed, developmental psychologists have increasingly recognized the value of secondary data analyses of extensive longitudinal studies that have been assembled over the last 60 to 70 years (e. g., a special issue of *Developmental Psychology* [January 1992] was devoted to this topic). An example that may help to clarify the use of dynamic systems as a conceptual and analytic tool in this context is outlined in Appendix 1.

With respect to the proposed program in human development, the major benefit that dynamic systems theory will provide will be the potential for integration. Some sense of the common themes that the substantive disciplines share, and hence the way in which the results that they are producing are likely to fit together, are now apparent. What dynamic systems theory will provide is the possibility of forging connections among these fields with a conceptual and analytic precision that would not have been possible as much as ten years earlier.

5.0 Forging a New Synthesis: The Learning Society

Although the material that we have covered in the previous sections is detailed and rather far ranging, the general conclusions that we draw are relatively simple. First, there is a pressing need to understand our current economic and social problems in human as well as purely technical terms: If we are to find a way to optimize the development of our human resources, we must examine the nature of our social institutions throughout the lifespan, and determine the extent to which they do or do not foster a lifetime of continuous learning and the ability to cope with change. Second, a number of recent developments have taken place in the fields that have direct bearing on our understanding of learning and development and that make the present moment a particularly opportune one in which to launch such an investigation. Finally, new analytic techniques have been developed which offer fresh ways of thinking and speaking about the new data and concepts which these disciplines have begun to offer.

In the present section, we indicate how we intend to make use of these various developments and techniques, and fashion an interdisciplinary inquiry whose scope will include the full lifespan, yet whose results will be concrete, specific, and of relevance to policy.

5.1 Situations Where Development Proceeds Successfully

The first major thrust of our effort will be to analyze examples where development appears to proceed particularly successfully, either throughout the lifespan, or for some clearly delimited part of it. Although defining success in this context is itself a serious question, for the present purposes we intend a somewhat generic definition, as in the various indicators of quality of life used for comparative purposes (by the UN, for example). More directly, outcomes in the areas of cognitive and social competence that are critical to prosperity, health, and psychological well-being are relevant to the interests of other CIAR programs, and form a core notion of successful development (cf. Section 5.5). We expect to cast a broad net to capture examples of successful development, both in our society and elsewhere. The goal is to understand the developmental processes involved, with the explicit understanding that adapting (rather than adopting) successful practices within our contemporary context is paramount.

One particularly well studied cross-cultural example has already been mentioned, and comes from contemporary Japan. As is well known, the performance of the Japanese economy since the second world war has been a very strong one. What is somewhat less well known is that Japanese educational attainments have also been far superior. For example, in several large studies that have been conducted, the worst Japanese schools have consistently performed at a level that is superior to the best schools in North America in the area of mathematics (Stevenson & Stigler, 1991). Nor do these achievements appear to have been attained at great expense. As a percentage of GNP, the Japanese spend far less on education than we do in North America. On the average, they also live many years longer, although they have a lower per capita expenditure on health care. The social class gradient is also far less steep, both in the area of education and the area of health. Finally, the popular perception that these achievements come at the cost of great stress to the child, at least in the elementary school, is clearly not correct (Sato,1991). While we are under no illusion that Japanese methods can simply be imported to North America, we believe that a detailed analysis of their institutions, and the relations of these institutions to development, will be instructive.

Another example that we intend to look at is the development of gifted children in our own society. Although gifted children are often thought of as possessing genetic talents (as indeed they may), it has also been shown that these gifts virtually never develop unless there is strong familial and other social-institutional support (Feldman,1986; Howe, 1990; Keating,1991). Examining the nature of this support and the way in which social institutions facilitate it will be another focus of our investigation.

5.2 Barriers to Learning and Development

A second facet of our research will be aimed at collecting and organizing existing data on suboptimal development, and the barriers or blocks that operate in such circumstances. Here we would hope to include not only social conditions in families, schools, and work organizations, but also in any biological predisposition with known neurological consequences. Conditions that are unique to Canada will be of particular interest to us in this regard, but conditions that are shared by Canada and other modern industrial cultures will also be deemed of great significance.

The specifics on which we decide to focus can not be predicted at the moment. However, it seems likely that we would want to gather any data that might be relevant from our particular specialties to such problems as conduct disorder, school dropout, learning disabilities, sensory processing deficits, and low adaptiveness to novelty or change. While existing reviews (e.g., Patterson,1990) will be useful, the particular use of them that we make will be distinctive, and we may want to put existing data bases to new uses.

5.3 Integrating Different Perspectives

The next component of our project will be one that is aimed at integrating the different perspectives that have been articulated, on each of the major developmental transitions that we study. For obvious reasons, we also can not anticipate what form this integration will take. This will depend on the particular perspectives that are presented by the program fellows and associates, and on the way each person's individual work evolves in the new group context.

Nevertheless, as a result of discussions that have already taken place, during the six months in which the task force has been meeting, it is possible to give at least some hint of the sorts of connections that are likely to be made through the exploration of one extended example. Consider, therefore, a few pieces of data that are emerging in the various disciplines that were mentioned earlier, with regard to the transition from home to formal schooling (which in most cultures takes place between the ages of 4 and 7 years).

On the basis of work conducted by Case and his collaborators, we know a fair amount concerning the central conceptual structures that are developed toward the end of the preschool period, and that have a major impact in determining children's ability to profit from the sort of instruction which they typically encounter in first grade -- at least in North America. One such structure has to with children's understanding of numbers, and is illustrated in figure 1.

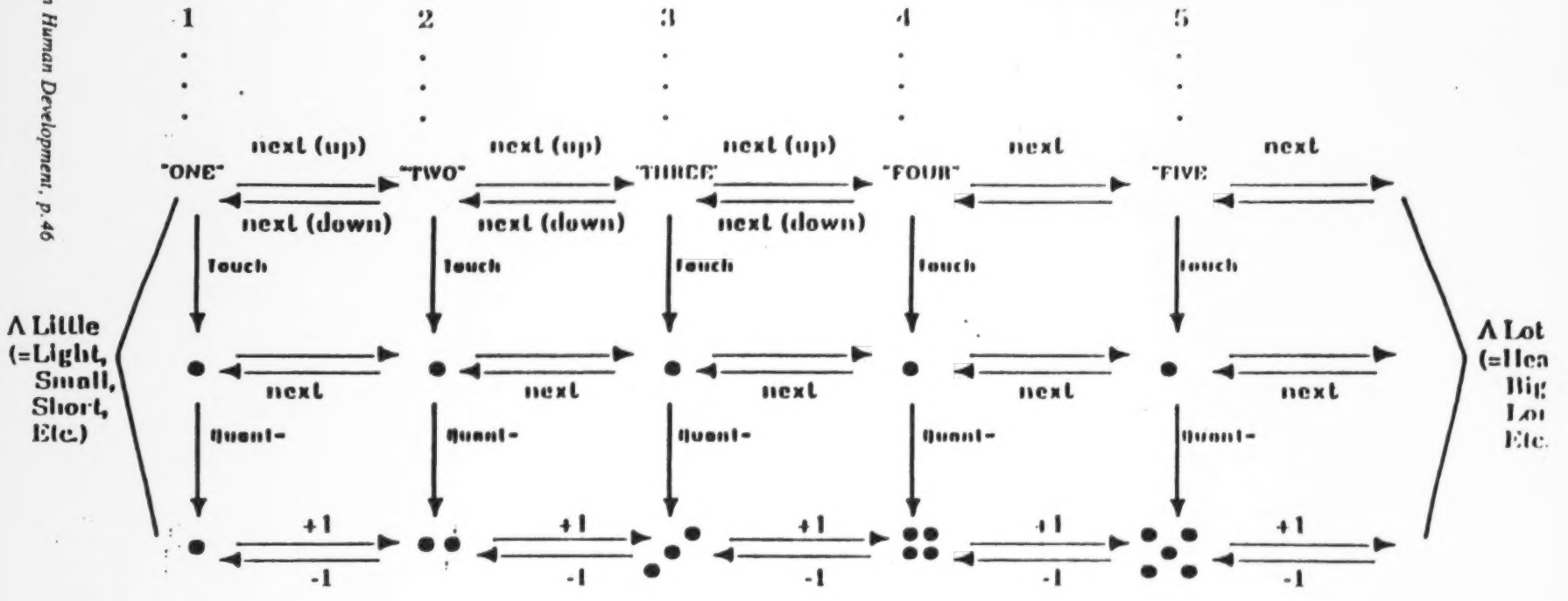

Figure 1
Cognitive Structure Underlying 6 year old's Numerical Understanding
(Dotted lines indicate "optional" (i.e. non-universal) notational knowledge)

The "mental number line structure" in Figure 1 is virtually never taught in school. Most of its components are deemed to be present already, and indeed most teachers are surprised to learn that some children may be missing certain aspects of them. The notion that a child might be able to count to 4 or 5, for example, and to recognize the numerals for 4 and 5, yet still not know that 4 is less than 5, comes as a surprise to many. Yet, this insight is crucial for understanding addition and subtraction. What Case has shown is that children who develop the structure in figure 1 during the period from 4 to 6 years tend to thrive in their first exposure to schooling, and to be enthusiastic about such subjects as arithmetic and elementary science.

As a result of his participation in the task force, and his exposure to Marmot's British civil service data, a question that Case has pursued over the last few months is whether a regular gradient exists with regard to the possession of the structure in figure 1, across social class. As mentioned in the introduction, the answer is affirmative. In fact, the lowest SES groups (which include children whose parents have immigrated to Toronto from rural Portugal), are already functioning at a level that is developmentally two years behind their upper class peers, at the time they enter the school system. One obvious implication of these findings is that the problems which such groups typically encounter in school math can not be laid entirely at the feet of the school system. At the very least, they must be presumed to lie in the match between the school system and the knowledge or learning style of those that enter it. These findings are particularly significant given the broader evidence on social class gradients in achievement, especially in mathematics, and on the long-term continuity of poor achievement from the entry years of schooling to high school and beyond (Entwisle & Alexander, 1990; Keating, 1990a).

In this regard, the way in which other countries manage school entry forms are an instructive contrast. For example, in Japan, beginning school is viewed somewhat differently from North America. First, the classroom is seen as a social environment very different from the family, one in which peer relations are prominent and adult-child relations (because of the numbers) hinge largely on teacher-centered activities that themselves require reliable levels of order, compliance, and communication. To the Japanese mind, children beginning along the path of formal schooling are making a transition from the dependency and intimacy of the home, especially the mother-child relationship, to a learning oriented existence in school where the habits of social interaction and cooperative learning require new skills in group participation and cooperation: ones that will last a lifetime. The essential difference with North America is the Japanese focus on the social environment and on the formation of group relationships as crucial to the transition to schooling, rather than on the individual and such things as cognitive and emotional "learning readiness."

The pre-school and first grade years are thus distinguished as a time in which a style of social learning is taught that then serves as a base for learning activities throughout the society. The same relational patterns and the same habits of group cooperation are reinforced time and again throughout the life of the individual as lived in this culture. The concentrated effort given to the establishment, in the early years, of a system of habits and cues also allows any teacher to run an orderly and efficient classroom, without strenuous effort, and without undermining spontaneous participation. And it may well be a crucial underpinning of subsequent Japanese achievements. Not only do Japanese children advance at faster rates in the middle and later grades of elementary school, they also stay together in this achievement.

The centrality of peer group techniques fosters the involvement of all the children, and makes it possible for the slower ones to be assisted by their peers. No streaming is used, and all children must learn a lesson before the class can go on. By thus keeping the children together as a learning group, the teacher is able to focus on the far more efficient instructional mode of addressing the entire class, punctuated by the use of small group cooperative leaning. There is evidence that much less time is spent "ordering" children and much more teaching them once a system like this is put in place, through intensive and patient early socialization at the time of transition from the family to the school (pre-school, kindergarten, and first grade).

When put together with the cognitive data mentioned earlier, a number of interesting questions emerge. One of these is whether the environment of the typical North American grade 1, with its individualistic emphasis, is not already rather well tuned to the environment of the average middle class home, and misaligned with the environment of the average lower class home, with regard to the form of social relations that exist, and that will be drawn upon for subsequent schooling. Data of relevance to this question come from a variety of sources.

On the negative side, there has been extensive epidemiological work on the problem of conduct disorders, which, according to the Ontario Child Health Study (see section 1.3), affects about 1 child in 20 in this province (Patterson, 1990). As Offord et al. (1992) have pointed out, the picture that emerges from the literature on parent management is extremely consistent with regard to the early home environment of those antisocial children who are hardest to treat. Parents of such children experience them as difficult to manage from an early age, and exhibit inconsistent and inadequate patterns of behavior themselves, in trying to deal with their children's aggressive impulses. When the children arrive in elementary school, they very soon experience difficulty in getting along with their peers; nor are they liked by their teachers. Not surprisingly, they also do poorly academically.

There is a parallel in the forms of treatment that appear effective as well. Although treatment is difficult, the current wisdom is that the best results come from programs that combine the following factors (1) work with parents, to bring their demands into line with those of the school, and make them more consistent, (2) training in the social skills necessary for getting along (and learning!) in a school environment, and (3) various forms of academic enrichment (Offord et al., 1991). Further comparison with data from other cultures on all these points might well be instructive.

Turning to the other end of the scale, one can also inquire on the match between the learning environment of the home and school in the case of children who receive early classification as "gifted" or (more rarely) as "child prodigies." Child prodigies, or highly gifted children, tend to come from homes where early interaction with adults is both intensive and extensive, in the sense that it involves opportunity to learn about the sorts of tools that are found in school (e.g., books, word processors) or in the discipline where the children reveal their specific talent (e.g., in the case of music, musical instruments). There is almost always strong parental expectation and encouragement toward achievement as well, and indeed both factors appear to be necessary (Csikszentmihalyi, 1990; Feldman, 1986; Howe, 1990; Keating, 1991).

Once again, these data fit nicely with the Japanese data in their global outline, while at the same time generating a set of interesting questions in their details. One final point is important to make, in this latter regard. There is still no perfectly satisfactory account that simultaneously explains all the existing naturalistic data, and the data on interventions. It is here that we hope the value of a dynamic systems approach will show itself. The effect of an intervention in a system can either be reinforced and magnified over time (via IFF's), or compensated for and completely negated, as a function of the initial conditions and the nature of the event in question. In fact, such systems are well known for what is termed "sensitivity to initial conditions."

What we ultimately hope to do, then, is to assemble data from various sources such as those that have been cited (but not restricted to them), to generate new evidence on specific aspects of development whose importance is highlighted by this analysis, and do a better job of modelling these data than has been done to date (via a dynamic systems approach), with the ultimate objective of providing results that can inform social policy as well as the social sciences.

5.4 Building a New Framework for Understanding the Determinants of Human Development

The work that was summarized in the previous section, in and of itself, does not suggest what a life span model of development might look like in which individual learning had a strong social and/or societal component. Indeed, it does not suggest whether any form of optimal development may be presumed to exist that transcends different cultures. Hopefully the work does illustrate the overlapping data and perspectives of some of the task force participants, however, and gives at least some sense of the questions that would start to emerge as a result of the efforts of those who joined the program. The final aspect of our project will also emerge only slowly, as our discussions of key developmental transitions throughout life gets underway, and our attempt to summarize such data on optimal and suboptimal development as are already available takes shape. Exactly what form this work will take can not yet be specified. Its focus, as already suggested, will be the development of a lifespan model of optimal development.

What we hope to do, then, is to build a model of optimal development, in which early social systems and the experiences they provide are seen as crucial to the development of early cognitive and affective structures, which in turn influence the balance of individual and group activity in which an individual engages, and the form each activity takes when it occurs. These structures then open up new possibilities for profiting from (or failing to profit from) later social systems and experiences, with a variety of possible individual "routes" being possible through the web of possible pathways that are thus potentiated. The adult phase of this process includes, of course, the possibility of intergenerational reproduction through parenting, but also through other forms of child caring activities (e. g., grandparenting, foster care, teaching, coaching, community work). The multiplicity of these processes then either foster or inhibit the potential that emerges from an entire group.

Before concluding, it is perhaps worthwhile to provide a final illustration of what we mean by this last statement. A major concern in Canada over the last decade has been the difficulty in sustaining what has been termed a "Science Culture." Most of the concern with regard to such a culture has been on the levelling or even decline in the proportion of students capable of pursuing higher education in the maths and sciences. This has traditionally been a greater problem for young women, and that pattern is continuing, perhaps even growing. Previous explanations for this gender difference have invoked fundamental ability differences or simple socialization accounts, such as differences in courses taken in high school. Other socialization accounts, rooted in early developmental differences, have also been explored.

When studied in isolation, many potential variables appear to make a modest contribution. A more comprehensive picture, however, is likely to depend on the simultaneous consideration of several broad factors and their systemic relationships. For example, a key transitional period for the emergence of gender differences is early to mid-adolescence. In North American society, this is typically a period of heightened awareness and concern for socioemotional development, particularly peer interactions. This emerges earlier for girls than for boys, given the average differences in the timing of puberty. Among the key social concerns are emerging interest in opposite-sex peer interactions, combined with a change in the structure of schooling.

Specifically, classroom practices become more competitive and impersonal at the point where girls find such interactions less desirable, especially when it involves competition with boys. This is further complicated by the fact that males view maths and sciences as highly male-stereotyped, raising the social costs for non-conforming young women (Hyde, Fennema, et al., 1990). Again, it is important to note that a variety of specific linkages have been explored, but the operation of an ongoing system that predictably generates a very small proportion of women in the areas of maths, sciences, and engineering has not been examined as a totality.

From the considerable amount of work that has been done to investigate the relative dearth of young women in mathematics and science careers, it is apparent that there are numerous influences. Previous efforts to integrate these findings into a coherent story have floundered. The evidence that many things each matter, but only a modest or small amount, is not easily integrated by existing linear models. Many of the influences are co-linear, and combining them does little to resolve the complexity of the phenomenon. A more coherent picture, however, is likely to emerge if these various influences are modeled with respect to their relative timing in the construction of a self-organized system. In this scenario, the gender differences in the timing of pubertal development, the attendant emphases on peer, and especially opposite-sex, interaction, the reorganization of school (and classroom practices) toward more publicly competitive aspects at this point in development, and the emergent conflict between socioemotional and achievement needs, are all relevant factors. But it is the opportunity to investigate competing models of how the system is formed that offers great promise for resolving previously unresolvable complexity into a coherent picture.

5.5 Relevance of Proposed Program to Existing Programs in Economics and Health

Traditional economics has never been capable of a dynamic modelling of the role of human resources or innovation for the reason that these dynamic factors are not readily amenable to simple quantification or input-output approaches. Investment in human resources, for example, is not a very precise way of gauging the learning that occurs. Nor is the stock of knowledge in a society or corporation a very accurate indication of how that knowledge is used. The generation of value through such things as innovation and problem-solving in production processes rests on very complex social systems of knowledge mobilization, which systems escape the usual economic analysis.

The Institute's program aimed at new economic formulations more consistent with the place of information in the creating of value will necessarily overlap greatly with this proposed project for these reasons. One matter of particular interest in this overlap is the kind of learning systems that surround the development and practical implementation of new, especially highly technical, products. It is in the area of innovation that the proposed project's emphasis on learning as problem solving and the economic project's focus on value creation will find a very close fit.

There are also strong potential connections with the program in Population Health. As a number of examples cited earlier have indicated, the findings of social class gradients in a range of health outcomes and the apparent effects of social support and perceived control as moderators of stress reactivity are likely to have important roots in early development. Of particular relevance here is the connection between epidemiological or "marker" models and developmental process models discussed earlier (Section 2.5). Unique opportunities exist here for the integration of population and individual development effects. Specifically, the role of early experience, and perhaps critical periods within early experience, in subsequent coping patterns, and hence health, would be an important focus.

It is perhaps useful also to consider the proposed human development project in relation to economic growth and population health simultaneously. Economic prosperity and the well-being of a population are, at the same time, key outcomes that serve to define the success of a society and key determinants of its continued successful functioning. Thus, consideration of the developmental determinants of broad social outcomes reveals again the crucial interplay of collective and individual development. An illustration of the relationship among the three programs is presented in figure 2.

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KEY REQUIREMENTS HUMAN WELFARE

AT THE INDIVIDUAL LEVEL

Learning	Health	Prosperity
(The informed, lively, engaged mind - rationality skill, intuition, civility character, values)	(Sound physical condition, ability to enjoy high quality of life, longevity)	(Sufficient to meet reasonable material & lifestyle needs; distribution perceived to be equitable)

AT THE SOCIETAL LEVEL

The Learning (Educated) Society	The Healthy Society	The Productive Society

Research to learn more about the determinants of these conditions

CIAR HUMAN WELFARE RESEARCH PROGRAMS

Program in Learning & Human Development	Program in Population Health	Program in Economic Growth and Policy
-Education system, pedagogy -Cognitive development & early child rearing practices -Social conditions, mores, values -Economic Conditions -Urbanization -Media Patterns -Education & Social Policy Culture (broadly defined)	-Nutrition -Hygiene -Economic Conditions -Genetic Factors -Health Care System -Health Policy -Human Qualities & Skills -Social Conditions & Values -Culture (broadly defined)	-Resources -Human Qualities & Skills -Institutions -Technology -Economic Policy -Social Conditions & Values -Culture (broadly defined)

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5.6 Conclusion

In conclusion, we would like to stress that initiating a program in human development seems particularly relevant in a Canadian context, for the following reasons. First, as a country, Canada is a good example of a state that possesses a world class university system, but which has failed to develop its potential for technical and scientific innovation fully, at least relative to its potential for other activities such as high level industrial management or monetary planning. Secondly, Canada has a core group of world class developmentalists, educators, cognitive scientists, and neuroscientists who are often vaguely aware of each other's work, but who have rarely bridged institutional and/or disciplinary boundaries in a sustained fashion. Finally, the country is at a crisis point in its own development. On the one hand, the importance of participating in the world economy at a more advanced technical level is being understood not as a desirable "frill," but as a vital necessity if the current level of social services is to be maintained and the national debt serviced. On the other hand, there are barriers toward doing so, particularly in a country with such a diversity of cultural institutions. Thus, there is a greater openness, both inside and outside the university, to any project that might offer clues as to how a society's institutions or institutional practices might best be structured, in order to optimize the level of expertise, health and creativity of its members.

Appendix 1

The relationship between the quality of life circumstances and experiences on the one hand, and well-being on the other, is an important example of a system that can be productively explored using dynamic systems models while also taking into account pathways and latent effects. As it happens, a number of relationships within the system have already been explored in some detail.

Two variables that appear to moderate the effects of adverse life circumstances and experiences are social support and perceived control. We have increasingly strong evidence that the presence or absence of early social connections has long-term consequences for development, and that high quality social support in childhood, whether from primary caretakers or others, can have an ameliorating effect throughout the life cycle. Similarly, there is substantial evidence to highlight the role of perceived control as a psychological mediator of the connection between adverse life experiences and health outcomes.

How does social connectedness actually make a difference to health? Valuable insights come from the fields of psychoneuroimmunology and psychoneuroendocrinology. It has long been known that the brain communicates with the endocrine system under conditions of acute stress (the fight or flight mechanism). Recently, it has been demonstrated that there is extensive two-way communication between the neural and immune systems which is modified, in poorly understood ways, by the quality of life circumstances and experiences. The long-term impact of these relationships is summarized in Robert Sapolsky's wry observation that medical students taught anatomy on cadavers of indigent people came to believe that the adrenal glands were larger than they normally are and that the thymus gland was smaller. In other words, adverse life circumstances would appear to lead to over stimulation of the adrenal secreting organs and suppression of the organs of the immune system.

Other biobehavioral connections are doubtless also important. The acquisition of specific behavioral patterns that are effective in moderating the level of stress that is experienced (often called coping mechanisms) is significantly related to one's experience in relevant social interactions. Similar relationships are evident in the study of perceived control. The degree to which individuals are free to choose their actions in response to stressful events appears to impact substantially on the degree of psychological and physiological consequences. Again, the specific biobehavioral linkages are under investigation.

But it is not merely the biobehavioral connections that are pertinent to understanding the dynamic action of this system. The experience of social support and the development of perceived control occur within both micro-level and macro-level social contexts. The varying patterns of attachment relations and encouragement of psychological autonomy are examples of specific, micro-level social interactions.

It is thus apparent from the extensive research on the connections among stressful events, health, and well-being outcomes, and the development of psychological and social moderators of that relationship, that there are numerous factors to be taken into account. As

well, we have begun to explore more precisely some linkages between adjacent levels of analysis. It is striking, however, that the pattern of outcomes yields greater consistency and coherence than would be implied by the enormous variety of influential factors. Coherence at a broader level that subsumes considerable local variability is often a signature of a self-organizing system. Additional characteristics of the stress/health relationship, some already noted, offer further indications that a dynamic systems approach is likely to be highly productive. A set of interrelated iterative feedback functions -- between the neural and immune systems, between patterns of early social interaction and later stress reactivity, between patterns of culture and social class and familial influences on perceived control -- appear to act in concert toward the production of systematic outcomes. Judging from the success of dynamic systems approaches to the analysis of similarly complex phenomena in other scientific domains, we view as high the probability that similar approaches to the analysis of the complexities of human development will be productive.

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